

**Internal Assessment Resource**

**Digital Technologies & Hangarau Matihiko Level 1**

This resource supports assessment against Achievement Standard 91881[[1]](#footnote-1)

**Standard title:** Develop an electronics outcome

**Credits:** 6

**Resource title:** Data Logging System

**Resource reference:** Digital Technologies & Hangarau Matihiko 1.5B Version 2

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| This resource:   * Clarifies the requirements of the achievement standard * Supports good assessment practice * Should be subjected to the school’s usual assessment quality assurance process * Should be modified to make the context relevant to students in their school/kura environment and ensure that submitted evidence is authentic |

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| Date version published by Ministry of Education | November 2019 Version 2  To support internal assessment from 2020 |
| Authenticity of evidence | Teachers/kaiako must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or student/ākonga exemplar material.  Using this assessment resource without modification may mean that students’ work is not authentic. The teacher may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

**Internal Assessment Resource**

**Achievement standard:** 91881

**Standard title:**  Develop an electronics outcome

**Credits:** 6

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**Teacher/Kaiako guidelines**

The following guidelines are supplied to enable teachers/kaiako to carry out valid and consistent assessment using this internal assessment resource.

Teachers need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing students against it.

**Context/Te Horopaki**

This activity requires students to develop a refined data logging system that can automatically respond to environmental data. For example:

* Measuring the hothouse temperature over a given time period and open/close a flap or turn on watering system.
* Measure water level of a fish/water tank and open a valve to fill, if needed.
* Measure light levels when a door is open or closed and sound an alarm.
* Measure humidity of a pot plant and water or mist, if needed.
* Measure sound level in a classroom and display on a visual feedback (appropriate - green, warning - yellow, too loud - red).

Students will develop their understanding of various ways to use sensors and output (display or controls) before being given this assessment. They should know how to use and program a microcontroller for a variety of analog and digital inputs (various sensors e.g. infrared reflective sensors, switches, LDR’s) and outputs (e.g. motors, LED indicators, displays). The student may use a given software template to test their system but must modify, test and debug it for their own outcome.

This assessment task may be modified to integrate the basic iterative processes with another type of digital technologies outcome, such as a computer program, develop a proposal and develop a design for an outcome, for example achievement standard 91883 *Develop a computer program*. Note: the task requirements will require modification to ensure the program meets the requirements of the 91883 programming standard.

This context can be easily adapted for other electronic environments where there is a combination of hardware and embedded software that performs to specifications.

Teachers should ensure the rigour of the outcome is appropriate for Level 6 of the NZ Curriculum. They may be teacher-given or developed in negotiation with the student.

**Conditions/Ngā Tikanga**

Where a group approach is used, the teacher needs to ensure that there is opportunity for each student to provide evidence for all aspects of the standard.

The 6 credits for the achievement standard indicates that approximately 60 hours needs to be allocated for teaching, learning (in and out of the classroom) and assessment in a programme of study.

Students are required to collect portfolio evidence as they complete the task. This could include annotated photographs, diagrams, short video clips, or code snippets that demonstrate understanding and explain decisions made by the student. If possible, the portfolio should be digital (e.g. wiki, website, or other information gathering applications).

**Note:** The intention of the standard is that learners construct an electronic outcome from basic components. Pre-configured data-logging tools that do not have a range of components from which learners can test and choose a range of outcomes are not suitable for this task. Additional information is presented below.

You may want to give students guidance on appropriate style and format for their evidence portfolio. This achievement standard does not assess format or style.

Conditions of Assessment related to this achievement standard can be found at <http://ncea.tki.org.nz/Resources-for-Internally-Assessed-Achievement-Standards>

**Resource requirements/Ngā Rauemi**

Students may need access to a computer, digital devices, the internet, and/or information from a variety of sources, such as manuals, and/or notes from textbooks, and access to a camera and/or video camera to photograph portfolio evidence. Some students may have cameras on their mobile phones, which can be used to document the process.

Each student will require a microcontroller system that includes various sensors, and is able to control actuators and displays, depending on the activity chosen (teacher-given or negotiated with student). Students will also need access to breadboards, multimeters, patch wires, IC’s and other basic components.

Basic interfacing procedures involve selecting, testing, and debugging of the hardware and software that allow different devices to work together to meet the given specifications.

Students also require:

* electronic circuit simulation software, for example:

[www.falstad.com/circuit/](http://www.falstad.com/circuit/)

[www.yenka.com](http://www.yenka.com)

[Tinkercad Circuits](https://www.tinkercad.com/things/0FHTc42tgSB-start-simulating/editel?collectionid=OIYJ88OJ3OPN3EA&lessonid=EHD2303J3YPUS5Z&projectid=OIYJ88OJ3OPN3EA#/sxs-viewer)

[Picaxe Editor 6](http://www.picaxe.com/Software/PICAXE/PICAXE-Editor-6/)

* an embedded programming IDE: [Arduino](https://www.arduino.cc/en/Main/Software), [Picaxe Editor 6](http://www.picaxe.com/Software/PICAXE/PICAXE-Editor-6/) or other.

**Additional information/He Kōrero Atu**

For this assessment, appropriate microcontrollers are Picaxe and Arduino or equivalent. Outcomes are constructed from basic components and subsystems where a certain amount of electronics knowledge is demonstrated to complete the task. Students must be able to make decisions on voltage required (choose appropriate batteries), current flow (limitations of microcontroller port outputs) and a choice of components to complete the task.

As part of the teaching and learning programme, ensure that students understand the interfaces, functions and components of the systems used. For example:

* a circuit as a complete path
* voltage as an energy path
* current as rate of flow of charge
* distribution of voltage and current through a circuit (series and parallel circuits)
* conduction (limited to the macroscopic behaviour of conductors, insulators, and semiconductors)
* circuit subsystems
* symbolic conventions and schematics
* hardware (for example components and combinations of components)
* embedded systems as software subject to hardware constraints.

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**Resource title:** Data Logging System

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**Student/Ākonga instructions**

**Introduction/Kupu Arataki**

This assessment activity requires you to develop a data logging system that can automatically respond to environmental data.

You are going to be assessed on the quality of the refined system that you develop.

This is an individual assessment task.

Teacher note: Insert due dates and timeframes

**Task/Hei Mahi**

You are going to create a data logging system using basic electronic components and a microcontroller. The system must perform to the specifications outlined in the task.

Identify and describe the relevant implications that are the most important for your outcome.

You should identify the implication, say what it means and what this might mean for your outcome. For example, you could:

* Describe what ethics is. Describe the ethical issues that relate to your outcome. What might you need to include in your outcome to ensure this is addressed?
* Describe what aesthetics is. Describe the aesthetic elements that relate to your outcome. What might you need to include in your outcome to ensure this is addressed?
* Describe what usability and functionality are. What does this mean in relation to your outcome? What might you need to include in your outcome to ensure this is addressed?

You will need to consider addressing these implications during the design, development and testing of your outcome.

**You must:**

* choose appropriate component types and values for your system
* modify, test and debug a functional model of your system
* use data sheets or calculations to assist in choosing appropriate component types and values for your system
* write well-structured, clearly commented, and readily understandable software.

As part of developing your outcome you will need to describe the interfaces and functions of the components of the systems used, explain the behaviour and function of the electronics outcome and justify your choice of the components and systems you have used. Examples of concepts that you can refer when demonstrating this requirement are:

* a circuit as a complete path
* voltage as an energy path
* current as rate of flow of charge
* distribution of voltage and current through a circuit (series and parallel circuits)
* conduction (limited to the macroscopic behaviour of conductors, insulators, and semiconductors)
* circuit subsystems
* symbolic conventions and schematics
* hardware (for example components and combinations of components)
* embedded systems as software subject to hardware constraints.

As you complete the task, gather evidence to include in a portfolio. This will be handed in with your completed data logging system.

**In your portfolio, you must include:**

* circuit diagrams
* layouts
* embedded software programs for each step of the task
* evidence of iterative improvement of the outcome.

**You may also want to include:**

* annotated diagrams and photographs, or videos
* journal entries with tables that describe your trialling and testing of circuits
* your responses to teacher questions
* interview notes from a scheduled teacher consultation
* test results.

**Specifications**

Your specifications must be agreed with your teacher prior to construction, and include sensors and a method to read environmental data, respond to data and provides output (this may be physical, auditory or visual).

The system will be a microcontroller-based circuit, and may use the following components:

* microcontroller, for example PICAXE, Raspberry Pi, Arduino, BBC Micro:bit, or other suitable system
* sensors e.g. temperature, light, humidity, sound, level detectors, motion.
* displays, LEDs and/or buzzers/speakers as indicators
* actuators to control relays, levers etc.

After the hardware has been selected:

* attach inputs or outputs to microcontroller and modify embedded programs that test each microcontroller input and output to ensure they function as expected.
* integrate embedded software programs to develop the outcome to meet specifications.
* the embedded software program needs to be well structured, readily understandable, and clearly annotated. The program may be based upon commonly available program stubs, sketches, examples, etc., but needs to be modified appropriately to meet the context. This means your program should:
* be clearly set out and correctly indented
* include comments that explain exactly what the program is doing at each step
* use labels so that it is easy to read and understand the program.

**Completing the task**

As you perform the task, make notes and gather evidence for inclusion in your portfolio. For example:

* show your use of appropriate resources and techniques used in developing your data logger.
* document the testing and iterative improvement you have made to your data logger throughout the development and testing process, showing evidence of your iterative testing procedures. This would generally include evidence of improvement through repeated cycles of trialling. For example:
* trialling and selecting the best type and value of components
* trialling and selecting the best arrangement of components
* adjusting hardware input and/or output parameters
* adjusting software parameters
* using a multimeter to measure and report voltage and/or current levels at indicated points.
* include diagrams, annotated photographs, written descriptions or video evidence to show your understanding of the interfaces and functions of the components you have selected for your system. This evidence should explain the behaviour and function of the outcome and show reasons (justify) for your choice of components and systems. For example:
* explain your choice of basic components to build your circuit, for example resistor to limit current and/or transistor to amplify current
* explain any calculations and/or research, for example manufacturer data sheets, that you used to determine the best components for your circuit
* describe how your circuit behaves in terms of the basic concepts, for example, a voltage divider, or the effect of a low battery
* explain the operation, function, and calculation of the electronic components you used in your circuit
* Undertake testing procedures to debug and diagnose the data logger to ensure fitness for purpose.

Examples may include:

* trialling and improving sub circuits and components
* trialling and improving embedded software for functionality and usability
* trialling and improving circuit layout
* trialling and improving circuit design and function
* trialling and improving the reliability of the circuit

Provide evidence of how you addressed the relevant implications that you identified and described in the process of developing the outcome. For example:

* How have you addressed ethical or intellectual property issues?
* How have you ensured that your outcome is usable and functional for your end users?

**In your portfolio, you must include:**

* circuit diagrams
* layouts
* embedded software programs for each step of the task.
* evidence of iterative improvement of the outcome.

**You may also want to include:**

* annotated diagrams and photographs, or videos
* journal entries with tables that describe your trialling and testing of circuits
* your responses to teacher questions
* interview notes from a scheduled teacher consultation.
* a short video showing the electronics outcome working

**Resources**

**Useful websites:**

<http://www.arduino.cc/en/>

<http://www.picaxe.com/>

[http://www.technologystudent.com](http://www.technologystudent.com/)

**Assessment schedule/Mahere Aromatawai: Digital Technologies & Hangarau Matihiko Achievement Standard 91881 –** **Data Logging System**

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| **Evidence/Judgements for Achievement/Paetae** | **Evidence/Judgements for Achievement with Merit/Kaiaka** | **Evidence/Judgements for Achievement with Excellence/Kairangi** |
| The student has developed an electronics outcome which involves:   * using appropriate resources and techniques when developing a functional combination of hardware and software that performs to specifications   The student has evidence of testing and debugging the input and output interfaces on expected analogue/digital inputs and outputs   * modifying and debugging embedded software   the student has evidence of modifying and debugging the software.They also have final code that allows for the data logger to function but it may not work reliably.   * using appropriate resources and techniques when developing a functional combination of hardware and software that performs to specifications   The student has evidence of testing and debugging the input and output interfaces on expected analogue/digital inputs and outputs   * modifying and debugging embedded software   the student has evidence of modifying and debugging the software.They also have final code that allows for the data logger to function but it may not work reliably.  The student demonstrates the data logger meets most of the specifications.  The student has described the interfaces and function of the main components and systems used within their outcome.  **For example (partial evidence)**  *Includes an input, processing, output system. They demonstrate individual programs to test the inputs and outputs that may be sample programs that have been modified for the system. They also have final code that shows correct operation for the system but it may not work reliably.*  ● describing the interfaces and functions of components and systems used  ● undertaking testing procedures to debug and diagnose the electronic system  **For example (partial evidence)**  *“I have used a LDR voltage divider to read the voltage into the ADC port that equates to light levels.” They showed a diagram of the interface between the Arduino and the sensor. “The LDR used was used to determine if a light should be switched on using embedded software.”*  **For example (partial evidence)**  *The student drew a completed circuit schematic with all the correct symbols and conventions. Using this, the student is able to describe the voltage and current flow requirements through the various subsystems. “In electronics, we talk about a circuit as a complete path. This means that electrons flow from a battery through the components and back to the battery again. Sometimes there are breaks and shorts in the path due to incorrect wiring. See my circuit diagram and photograph with notes showing a completed circuit without short circuits or disconnections.”*  ● describing relevant implications.  **For example (partial evidence):**  *future-proofing - is the process of making sure that the outcome will continue to be made available for future use based upon software and hardware*  *Functionality - that the outcome works as expected.*  *The examples above are indicative samples only.* | Develop an informed electronics outcome.  ● modifying, debugging and commenting software so that the program is logical and readily understandable  ● undertaking testing procedures to debug and diagnose the electronic system to improve the reliability  ● explaining the behaviour and function of the electronics outcome  The student has:   * demonstrated a system that meets all the specifications reliably. * written their own software using examples. The code is well documented and easy to understand. * used a more structured testing approach and programs are clearly annotated. * explained the behaviour and function of components/subsystems used in the construction of the data logger.   **For example (partial evidence)**  *“I realised I need to boost the current to the servo as the servos draw at least 100mA but the Arduino output port can only deliver 40mA. I decided to use a separate supply for the servo.”*  *“I have used a LED as an indicator to show that my system is on. I calculated the resistor value required using Ohm’s law. The resistor is required to limit the current through the LED to about 10 mA otherwise it will blow.”*  *“I used a temperature sensor to measure the temperature of the classroom so I know when to turn on the fan.”*  ● addressing relevant implications.  **For example (partial evidence)**  *The student used only open source code when getting ideas for their embedded software program and have kept attribution within the code as comments.*  *The student related their choice of each component to its importance for the functionality of the outcome.*  *The examples above are indicative samples only.* | Develop a refined electronics outcome.  ● undertaking testing procedures to debug and diagnose the electronic system to ensure it is fit for purpose  The student has:   * demonstrated a data logger that meets the specifications and is fit for purpose. The system is well-constructed. Testing procedures and documentation shows the student has improved the system iteratively to provide a better outcome.   **For example (partial evidence)**  *“I have decided to try various positions in the room for my temperature sensor, because the northern wall was hotter than the southern wall, to make the system more reliable. I also had to make sure the sensor is in the shade.”*  Students have provided evidence of improvement through a repeated cycle of trialling and testing during the design, development and testing process. For example:   * trialling and improving sub circuits and components * trialling and improving embedded software for functionality and usability * trialling and improving circuit layout * trialling and improving circuit design and function * trial that the circuit functions reliably * testing reliability   ● justifying the choice of components and systems used in the development of the electronics outcome  **For example (partial evidence)**  *“I calculated the resistor value for my LED on my microcontroller to be … using Ohm’s law in this way (see my calculation and explanation). I wanted the LED to be bright enough for the light to be seen at a distance on a bright day. I chose the capacity of the battery for my project to be … based upon my calculations of the current demands of my circuit with… LEDs, servo… Here are my calculations…”*  *“I tested my servo and found that it could not be run directly by my microcontroller 5V output. So I used a separate power supply because the microcontroller is limited to providing X current and my servo requires Y current.*  *The microcontroller has… which can be used along with some code to control the function of the circuit. It does this by… I found some errors in the code on testing which I fixed by…”*  *“I researched three types of temperature sensors… Their specifications are… I chose... as the specification for my relay is… and then I knew that my chosen transistor would not overheat/explode/cease to function. The effect of swapping the transistor in the circuit is…”*  *The examples above are indicative samples only.* |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the Achievement Standard.

1. This achievement standard is derived from both *The New Zealand Curriculum* and *Te* *Marautanga o Aotearoa.* [↑](#footnote-ref-1)