 Stage 4 technology mandatory digital technologies

The Digital Technologies context encourages students to develop an empowered attitude towards digital technologies, use abstractions to represent and decompose real-world problems, and implement and evaluate digital solutions. Students have the opportunity to become innovative creators of digital technologies in addition to effective users of digital systems and critical consumers of the information they convey. Students are provided with opportunities to develop fluency in a general-purpose programming language and use these skills to solve information problems and to automate repetitive tasks.

Crack the code

Using control technologies, students are required to individually design, produce and evaluate an alarm/alert system using a coding software (e.g. Arduino) and relevant hardware. The system must include correct coding, working inputs and outputs and include a specified end-use application. Throughout the unit, students will learn programming concepts and commands and how to modify code to suit an identified need. Students will also learn how to assemble basic electronic circuits using a microcontroller to produce their final design idea.

**Extension:** Students can modify the code to add functionality to their project design which adds complexity to their code.

Outcomes

* Design and production skills TE4-1DP, TE4-2DP, TE4-4DP
* Knowledge and understanding TE4-7DI
* Technologies and Society TE4-10TS

**Related life skills outcomes:** TELS-1DP, TELS-2DP, TELS-3DP, TELS-5DP, TELS-8DI, TELS-11TS

Resources

* PowerPoint “Crack the Code presentation V3.0”, July 2018
* “Crack the Code” Teacher Information Booklet V3.0, July 2018
* “Crack the Code” Student Work Booklet V3.0, July 2018
* [Arduino software (open source)](https://www.arduino.cc/)
* [Museum of Applied Arts and Sciences](https://maas.museum/learn/thinkershield/)
* [Circuit illustration software](http://fritzing.org/download/) (open source)
* Optional Video Resource available from [vea.com.au](http://vea.com.au/)
* [MAAS ThinkerShield](https://maas.museum/product/thinkershield/) (to purchase)
* [Electronic components list](%E2%80%A2%09https%3A/schoolsequella.det.nsw.edu.au/file/88f2769b-6d53-4114-83d5-1f024eb43861/1/crack-the-code-teacher-information-booklet.docx)
* [Crack the code ready reckoner](%E2%80%A2%09https%3A/schoolsequella.det.nsw.edu.au/file/88f2769b-6d53-4114-83d5-1f024eb43861/1/electronics-ready-reckoner.docx)

Register program in the last column.

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| Sequence | Outcomes | Content | Suggested strategies and assessment | Resources | Registration |
| Weeks 1-2 | TE4-1DPTE4-2DP | Define and decompose real world problems, taking into account functional requirements and a range of constraints, e.g. economic, environmental, social, technical and usability (ACTDIP027) | Overview of Crack the Code unitClassroom expectations and organisationTeacher:* distribute work books to students.
* introduce students to the classroom drawing upon prior learning experiences.
* explain that the glossary will be completed progressively throughout the unit as new concepts are learnt.

Students:* complete glossary terms to demonstrate knowledge of content metalanguage

**Identifying and defining**Design process* Teacher:
* introduce students to the design process.
* explain the importance of ongoing evaluation throughout all design projects.
* read design situation and brief. Explain the project constraints.

Students:* Highlight key terms in the brief and record in work booklet.
 | Crack the code teacher information bookletCrack the code student bookletFunctioning example of the project |  |
| Weeks 1-2 | TE4-1DPTE4-2DP | Develop criteria to evaluate design ideas, processes and solutions, the functionality, aesthetics and a range of constraints, e.g. accessibility, economic, resources, safety, social, sustainability, technical (ACTDEP038, ACTDIP027, ACTDIP031) **DT ST** | Identifying and definingEvaluation criteriaAs a class:* establish an evaluation criteria and then refine to 5 key points:
* Control system
* Alert/alarm system
* Must use a microcontroller
* Must include working inputs
* Must include working outputs

Students:* record evaluation criteria in work book.
 | Whiteboard and markerCrack the code teacher information bookletCrack the code student booklet |  |
| Weeks 1-2 | TE4-7DI | Evaluate how existing information systems meet needs, are innovative and take account of future risks and sustainability (ACTDEK029, ACTDIP031)  | **Identifying and defining**Control technology systemsTeacher:* explains examples of simple control technology systems
* Traffic lights
* Refrigerator
* Dishwasher
* how does a basic control technology work?
* watch [Tickle-Me-Elmo YouTube clip](https://www.youtube.com/watch?v=65maMPzLFjg) (mute volume)
* question students about how the toy works. (see discussion questions in PPT Notes section and student booklet).

Students:* record examples of common control technology systems
* complete questions about how basic control technologies work to demonstrate their understanding in their work booklet

Teacher:* use the images in the slideshow to explain to students the electronic components are used on a household television remote and how they form a circuit to control the outputs (see PPT Notes section for answers). Note: If you have a tactile example this may improve student engagement

Students:* record component definitions in booklet.
* label remote control components diagram to build knowledge of control technologies

Teacher:* explains how control systems work using an Input Processing Output (IPO) model with reference to examples discussed previously.
* Input device (sensor)
* Processor (decision maker)
* Output (actuator)

Students:* complete IPO chart in folio to refer throughout the unit
* use Think Pair Share to brainstorm examples of control technologies. Record in folio
* define ‘control technologies’ and share with class.
* create a class definition of control technologies
* record in glossary
 | PowerPoint Presentation. ‘Control Technologies: What are they and how do they work?’ Teacher notesData projector, screen, speakers and computerCrack the code teacher information bookletCrack the code student bookletTV remote control |  |
| Weeks 1-2 | TE4-7DITE4-10TS |  Identify social, ethical and cyber security consideration of digital solutions | Testing and evaluatingComplete worksheet / activities outlined on page 12 of student workbook. Class discussion of relevant issues identified while completing the above activities. | PowerPoint Presentation. ‘Control Technologies: What are they and how do they work?’ Teacher notesData projector, screen, speakers and computerCrack the code teacher information bookletCrack the code student booklet |  |
| Weeks 1-2 | TE4-7DI | Evaluate the suitability of hardware with particular performance characteristics against the needs of different users (ACTDIK023) | Identifying and definingMicrocontrollersTeacher explains:* what a microcontroller is and the functions it performs
* Programmable Logic Controllers (PLCs)
* how a microcontroller works

Students:* complete cloze passage to learn new specific content metalanguage and to gain knowledge of microcontrollers

Teacher introduces the:* Arduino Microcontroller
* MAAS ThinkerShield

Note: support with a tactile examples to support student engagementStudents familiarise themselves with the microcontroller and ThinkerShield components to support their future coding practise in this unit. Students:* labels Arduino Microcontroller diagram
* records a definition of a ‘shield’
* labels MAAS ThinkerShield diagram
 | PowerPoint Presentation. ‘Control Technologies: What are they and how do they work?’ Teacher notesData projector, screen, speakers and computerCrack the code teacher information bookletCrack the code student bookletMAAS ThinkerShieldArduino Uno microcontroller and cable |  |
| Weeks 1-2 | TE4-7DI | Investigate how digital systems represent text, image and audio with whole numbers (ACTDIK024) | Researching and planningSetup and experimentTeacher explains and demonstrates:* how to connect the Arduino board and ThinkerShield to the computer
* identify safety concerns when using a microcontroller

Students:* connect Arduino board and ThinkerShield to computer
* identify board and port
* students demonstrate an understanding of the safety issues associated with the hardware by listing them in their work booklet.
 | PowerPoint Presentation. ‘Control Technologies: What are they and how do they work?’ Teacher notesData projector, screen, speakers and computerMAAS Booklet 2015 ‘Get on with it’Crack the code teacher information bookletCrack the code student bookletClass set of MAAS ThinkerShieldsClass set on Arduino Uno microcontrollers and cablesComputer room with Arduino software |  |
| Weeks 1-2 | TE4-4DPTE4-7DI |  Trace algorithms to predict output for a given input and to identify errors (ACTDIP029) | Testing and evaluatingLoading the sketchTeacher demonstrates:* how to load the Blink Sketch and introduces the Interactive Development Environment (IDE) by identifying the key functions of the sketch

Students:* load the Blink sketch and run code to build a knowledge of the commands in the IDE
* use wordbank to complete the ‘understanding the sketch’ diagram
* record the meanings of the sketch command functions you have a tactile example this may improve student engagement

Arduino languageTeacher:* outline the use of computer programming language and how it makes a microcontroller perform certain functions.

Student:* completes cloze passage using PPT resource

Pseudo-codeTeacher:* introduces the concept of pseudo-code

Students complete activities on pseudo-code to compare their logic to the program logic:* activity 1: lay on floor (see instructions in PPT)
* activity 2: Write the pseudo-code in work booklet to make the light in the room blink on and off

PRP#01: Digital Output - BlinkStudents:* complete the control system IPO chart to control an Light Emitting Diode (LED)

Activity: Making ConnectionsTeacher* directs student to re-run the blink program and observe the connections between the pseudo-code and the Arduino code.

Students* label the components of the Arduino in Blink sketch
* complete the table to outline the function of each component
* apply their understanding of the content so far by modifying the Blink Sketch to complete a series of challenges.
* reflect on their progress by completing the self-reflection.

Teacher:* provides feedback on student achievement.
 | PowerPoint Presentation. ‘Control Technologies: What are they and how do they work?’ Teacher notesData projector, screen, speakers and computerCrack the code teacher information bookletCrack the code student bookletClass set of MAAS ThinkerShieldsClass set on Arduino Uno microcontrollers and cablesComputer room with Arduino software |  |
| Weeks 1-2 | TE4-4DP | Design algorithms that use a range of data types, branching and iteration and represent them diagrammatically and in English (ACTDIP029) **CT DT**  | **Researching and planning**Commands in ArduinoTeacher:* explains the three main parts of the Arduino sketch and how to use variables.

Students:* experiment by changing the integer command in the Sketch. Note: this will make it easier to code later on

Teacher:* explains how ‘if’ statements are used in Arduino programming language
* explains how branching diagrams are used to determine possible actions to be performed, depending on specified conditions to determine an algorithm.

Students:* sketch a branching diagram for a:
* child’s night light
* Mortein Peaceful Nights
 | PowerPoint Presentation. ‘Control Technologies: What are they and how do they work?’ Teacher notesData projector, screen, and computerCrack the code teacher information bookletCrack the code student bookletTechnology Mandatory syllabus Years 7-8 2017 page 61 |  |
| Weeks 1-2 | TE4-7DI | Explain how and why whole numbers are represented in binary in digital systems (ACTDIK024) | Researching and planningBinary numbers – why?Teacher:* explains the use of binary numbers and how they relate to coding and computer technology
* demonstrates how binary numbers can be converted to text using an [online converter](https://www.rapidtables.com/convert/number/binary-to-ascii.html)

Students gain background knowledge on binary to support their understanding of computer coding. Students:complete cloze passage using the wordbank provided | PowerPoint Presentation. ‘Control Technologies: What are they and how do they work?’ Teacher notesData projector, screen, and computerCrack the code teacher information bookletCrack the code student booklet |  |
| Weeks 3-4 | TE4-7DITE4-4DP | Collect and access data from a range of sources (ACTDIP025)  | Researching and planningInputs (sensors)Teacher:* introduces a variety of input components that are used in control technologies. Explain the function of the following examples:
* switches
* motion sensors
* light sensors
* sound sensors
* level Sensors
* pressure sensors
* thermal sensors
* mechanical Sensor (Potentiometer)

Students:* list examples of common items which use varying sensors in their work booklet

PRP#02: Digital Input – ButtonStudents:* complete the control system IPO chart to control an Light Emitting Diode (LED) with a button

Teacher demonstrates:* how to load the Button sketch

Students:* load Button sketch and run code
* change the pin number to 7 on the ThinkerShield to allow the button to be used as the input in the control system
* modify the code to allow functionality

The Integer “Int” Command in useTeacher and students identify the integer command in the Button Sketch and discuss its significance.* to allow intuitive labels for pins and other values.
* to simplify changes to pins in the code

Students complete* the pseudocode for how to make a light turn on and off using a switch.
* making connections questions to reflect on their logic vs the program logic
* a series of challenges where they modify the Button sketch to change the functions.
* evaluation questions

Teacher:* provides feedback of student achievement.

PRP#03: Analog Input – Potentiometer and LDRStudents:* complete the control system IPO chart to control an Light Emitting Diode (LED) with a potentiometer

Teacher:* demonstrates how to load the Analogue Input Sketch

Students:* load Analog Input sketch and run code
* change the pin number on the ThinkerShield to allow the potentiometer (pin 4) to be used as the input in the control system

Serial MonitorTeacher:* demonstrates how to view the Serial Monitor so that the students can see the number values associated with the Potentiometer control

Students complete:* pseudocode to make the LED blink faster and slower depending on the number values on the serial monitor
* making connections questions to compare their logic to the logic in the sketch
* a series of challenges where they modify the Analog Input sketch to change the functions, including changing the input to the Light Dependant Resistor (LDR).
* evaluation questions

Teacher:* provides feedback of student achievement.

Outputs (actuators)Teacher:* introduces a variety of output components that are used in control technologies. Explain the function of each.
* light
* sound
* motion

Students:* identify and record common items which use the outputs listed

PRP#04: Digital Output – BuzzerStudents:* complete the control system IPO chart to identify the inputs and outputs required
* type up sketch from workbook

Students complete:* pseudocode to make buzzer sound
* making connections questions to compare their logic to the logic in the sketch
* additional: change the code to modify the tone of the buzzer so that it sounds like an alarm
* complete a series of challenges where they modify the Buzzer sketch to change the functions
* completes evaluation questions

Teacher:* provides feedback of student achievement.

Extension ActivitiesStudents can modify the code to:* enhance the quality of the code
* change some of the variables
* add a sensor and change the alarm characteristics
* make a simple car alarm
* make use of the tone command

Suggested Video: Introduction to Programming: Unlocking the Secrets (VEA, 2006)* this video is very useful for explaining the basics of creating computer programs including creating algorithms, fundamentals of computer languages and process of writing and compiling programs. The video content explains these concepts in a meaningful way and helps make connections for students to abstract concepts.
* if you choose to use this resource, you will need to access the VEA worksheet and print the section ‘During the Program’ for students to complete.
 | PowerPoint Presentation. ‘Control Technologies: What are they and how do they work?’ Teacher notesData projector, screen, and computerCrack the code teacher information bookletCrack the code student bookletClass set of the MAAS ThinkerShieldsClass sets of the Arduino Uno microcontrollers and cables[vea.com.au](http://www.vea.com.au/secondary-school/introduction-to-programming.html)  |  |
| Weeks 5-7 | TE4-1DPTE4-2DPTE4-4DP | Design the user experience of a digital solution, generating, evaluating and communicating alternative ideas (ACTDEP036, ACTDIP028, ACTDIP032) **CT DT**  | Researching and planningTeacher:* explains the Know Want Learned (KWL) Chart and references the:
* design brief
* project constraints
* criteria for success

Students:* review the design brief at the beginning of the workbook and complete the KWL chart
* consider the components required for their project and complete a IPO chart using the template provided
* brainstorm possible design solutions

Teacher:* explain that students will need to develop four basic control system designs using the Arduino technology. Teacher provides ideas of good design solutions e.g. closed loop, simple functions, have an appropriate end-use application.

Students:* generate 4 possible design ideas from their brainstorm. Each must have a name, end-use application and a IPO chart
* evaluate each design idea using Plus, Minus and Interesting (PMI)
* can use their class work as stimulus and research other possible ideas on the Internet.

Constraints:* use a microcontroller e.g Arduino
* include working inputs (sensors) and outputs (actuators)
 | Crack the code teacher information bookletCrack the code student booklet |  |
| Weeks 5-7 | TE4-2DP | Plan and manage projects individually and collaboratively (ACTDEP039)  | Producing and implementingStudents complete:* time/action plans by identifying the action/activity, time of expected completion and ongoing evaluation
* finance planning to determine project costs
* list possible websites to source project components
 | Crack the code teacher information bookletCrack the code student booklet |  |
| Weeks 5-7 | TE4-1DPTE4-4DP | Implement and modify programs involving branching, iteration and functions in a general-purpose programming language (ACTDIP030) **CT**  | Producing and implementingTesting of IdeasStudents* choose two possible design ideas to test
* test the chosen design ideas against the criteria for success and include a screen shot of the code to be inserted into the workbook
* evaluate each design solution using Plus, Minus and Interesting (PMI)
* justify their final selection based on the two trials and evaluation criteria

Note: once the code is correct using the ThinkerShield, students will need to remove the ThinkerShield and assemble their control system using electronic components. | Crack the code teacher information bookletCrack the code student bookletClass set of the MAAS ThinkerShieldsClass sets of the Arduino Uno microcontrollers and cables |  |
| Weeks 8-9 | TE4-1DPTE4-2DPTE4-4DP | Implement a functioning user interface (ACTDIP030)  | Producing and implementingFinal designStudents* edit final design and present as a tactile, working project.

Students produce:* IPO chart of their control system
* materials list for their final design
* production plan and ongoing evaluation
* a working circuit to run their code on

Presentation options:* students can create a video diary to document their process and record the use of their design solution at home.
* students can present their design process to the class in the form of an oral presentation, document the prototype in the form of a video diary or other multimedia presentation

Components of circuitsStudents:* identify different circuit components in their workbook using the word bank provided.
* identify which components are classified as sensors and actuators

Teacher:* explains what each component is and their function.
* information about some component can be found below to assist in your explanation.

Understanding electronic circuits and ArduinoTeacher explains:* the flow of electricity in a circuit
* use of a power source
* use of a resistor
* open and closed circuits

Tools, equipment and safety concerns with control technologiesTeacher:* introduces tools and equipment that will be used in the construction of electronic circuits throughout the unit of work
* question students to consider the safety issues associated with each

Students:* identify each piece of equipment, its use and the safety concerns for each.

Note: there is space provided for an additional piece of equipment of that is relevant to you.Circuit assemblyTeacher:* demonstrates different methods of how to assemble a basic circuit
* identifies the safety concerns for each

Follow WHS guidelines, ESISSafety testing, recording and file | Resource: Planning tool for circuit assembly and Arduino – [fritzing.org](http://fritzing.org/download/)Crack the code teacher information bookletCrack the code student bookletClass set of the MAAS ThinkerShieldsClass sets of the Arduino Uno microcontrollers and cablesReady ReckonerElectronic components (see order list) PliersInformation about circuit components: [LED](https://www.youtube.com/watch?v=T99kfbQRGD0&index=12&list=PLA9212719342ED971), [resistor](https://www.youtube.com/watch?v=TZYlPQU9B4M&list=PLA9212719342ED971&index=2), [diode](https://www.youtube.com/watch?v=MVy_MG0X2h4&index=1&list=PLA9212719342ED971), [potentiometer](https://www.youtube.com/watch?v=MXFvWLrpVSk&index=3&list=PLA9212719342ED971) and [breadboards](https://www.youtube.com/watch?v=l-TnHfwi-WY&list=PLA9212719342ED971&index=5). |  |
| Week 10 | TE4-1DPTE4-2DP | Evaluate how student solutions address defined functional requirements and constraints (ACTDIP031)  | Testing and evaluatingFinal evaluationUsing Blooms Taxonomy to reflect on their learning process by completing the final evaluation. | Crack the code teacher information bookletCrack the code student booklet |  |

All outcomes referred to in this unit come from [Technology Mandatory Syllabus Years 7-8 Syllabus 2017](http://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/technologies/technology-mandatory-7-8-new-syllabus)
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