 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.

Fast and curious – developing future and systems

In collaboration with Oracle using Anki Overdrive cars, students are invited to test themselves to complete a series of individual programming challenges of which they can apply to real world problems. Students need to investigate real world problems and find solutions. Students will have the opportunity to take their solutions and collaborate with students from other schools to solve larger real word intricacies.

* Students gain an understanding of digital connectivity.
* Using Anki vehicles to explore, investigate and experiment with the Internet of Things and Driverless Vehicles (Unconnected Vs connected cars).
* Interpreting data to product code to complete challenges.

Students will use their understanding to design a Smarter City.

Throughout the unit of work the content marked with an \* indicate opportunities for assessment of, for or as learning, However recommended assessments include:

* Anki car programming challenges (individual)
* Network modelling diagrams and Infographic (group)
* Smarter City design and presentation including data analysis (group)
* Student workbook portfolio (individual)

Outcomes

* TE4 1DP designs, communicates and evaluates innovative ideas and creative solutions to authentic problems or opportunities
* TE4 2DP plans and manages the production of designed solutions
* TE4 4DP designs algorithms for digital solutions and implements them in a general-purpose programming language
* TE4 7DI explains how data is represented in digital systems and transmitted in networks
* TE4 10TS explains how people in technology related professions contribute to society now and into the future

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

[Smart City alternative view](https://www.theguardian.com/cities/2014/dec/17/truth-smart-city-destroy-democracy-urban-thinkers-buzzphrase)

[Smart Cities – Infrastructure and Transport of the Future](https://www.youtube.com/watch?v=d1DndVz9dAs)

[Smart Cities](https://www.youtube.com/watch?v=Br5aJa6MkBc)

[Trackless Trams](https://www.youtube.com/watch?v=UKIKKIWNg4E)

[Real Time Board](https://realtimeboard.com/index/)

[Padlet](https://padlet.com/)

[Scalextric](https://www.scalextric.com/uk-en/)

[How a driverless car sees the road](https://www.ted.com/talks/chris_urmson_how_a_driverless_car_sees_the_road?language=en)

[Oracle IoT and Anki Overdrive system](https://www.youtube.com/watch?v=yZ85FsGA9lQ)

[Anki under the hood](https://www.youtube.com/watch?v=1tmcHqIEfXQ)

[Gov Hack](https://www.govhack.org/)

[Make a Caesar Cipher](https://www.stemlittleexplorers.com/en/how-to-make-cipher-wheel/)

[Caesar Cipher](https://cryptii.com/pipes/caesar-cipher)

[Coding Caesar Cipher](https://trinket.io/python/5868d7f20c)

[Anki Tear down](https://www.microcontrollertips.com/teardown-inside-anki-overdrive-racecar-set/)

[The Internet: Wires, Cables & Wi-Fi](https://www.youtube.com/watch?v=ZhEf7e4kopM&feature=youtu.be&list=PLzdnOPI1iJNfMRZm5DDxco3UdsFegvuB7)

[CS Unplugged Tablets Of Stone](https://classic.csunplugged.org/network-protocols/)

[The Internet IP and DNS](https://www.youtube.com/watch?v=5o8CwafCxnU&index=3&list=PLzdnOPI1iJNfMRZm5DDxco3UdsFegvuB7)

[CLI Image](https://avc.com/2015/09/the-return-of-the-command-line-interface/)

[Infographics](https://www.canva.com/)

[Exact Instructions](https://www.youtube.com/watch?v=cDA3_5982h8)

[Flowcharts](https://www.lucidchart.com/pages/flowchart-symbols-meaning-explained)

[Python Turtle Racetrack](https://projects.raspberrypi.org/en/projects/turtle-race/3)

[Challenges](http://edu.opcau.com/)

[Instructions](https://opcau.github.io/anki/IoTRaceTrack/#build)

[Smart City video from Oracle Italy](https://www.youtube.com/watch?v=x2wMzMjsSGo)

[The Moral Machine](http://moralmachine.mit.edu)

[Etcher](https://etcher.io/)

Register program in the last column.

| Sequence | Outcomes | Content | Suggested strategies and assessment | Resources | Registration |
| --- | --- | --- | --- | --- | --- |
| Weeks 1-2 | TE4-1DP | Identifying and defining | TeacherIntroduces design process, unit and resources.Provides Design Situation:In thirty years’ time 70 percent of the world’s population is expected to live in cities.All these people living together will need more food, create traffic jams, need more energy, create more waste, require more health care and so on.To help overcome these problems people are turning to the Internet of Things to find solutions. The Internet of Things uses data from connected devices and sensors to help plan and make decisions.Your team has been selected to design a system for a Smart City that uses the Internet of Things (IoT).Your team will make a model of the smart city and program the cars to simulate your solution. | Teacher workbook[Teacher reading](http://dataconomy.com/2015/12/how-data-science-is-driving-the-driverless-car/)Big data and driverless cars |  |
| As above  | As above | As above | StudentTo accomplish this task you will need a good understanding of how data can be collected, stored and analysed to help make better decisions. Students watch: What is a Smart city? | Student workbook[What is a smart city?](https://www.youtube.com/watch?v=Br5aJa6MkBc)Internet of Things |  |
| Weeks 1-2 | TE4-1DPTE4-2DP | Identifying and definingDefine and decompose real-world problems, taking into account functional requirements and a range of constraints, for example, economic, environmental, social, technical and usability. (ACTDIP027) | Deconstructing the ProblemTeacherShows YouTube video ‘step into the city of the future’ to give students understanding of what a smart city is. Read over the design situation and design brief with the class.Students highlight or underline key words to include in their ongoing glossary for the unit. Teacher explains or leads discussion on keywords, including:* Smart City
* Data
* IoT
 | [Smart Cities: Step into the city of the future!](https://www.youtube.com/watch?v=RKWuj1OlDPo) |  |
| As above | As above | As above | Students* Add definitions to the glossary in their workbooks
	+ These should be added as they appear within the unit.
 | Student workbook |  |
| Weeks 1-2 | TE4-10TS | evaluate how existing information systems meet needs, are innovative, and take account of future risks and sustainability(ACTDEK029, ACTDIP031) | Teacher* Introduces lesson with the YouTube video ‘smart cities – infrastructure and transport of the future’ and ‘smart cities: solving urban problems using emerging technologies’
* Leads discussion surrounding the amount of cars on the road. How to reduce that amount – public transport (for example: busses over the top of traffic in Asian countries, community transport, future solutions and so on)
* Leads discussion about energy efficient travel solutions
 | [Smart Cities – Infrastructure and Transport of the Future](https://www.youtube.com/watch?v=d1DndVz9dAs) |  |
|  |  |  | StudentsBrainstorm current real world problems and investigate emerging technological solutions to overcome those problems. (besides smart cars as this topic has been discussed in class)Note: real world needs to relate to the local built environment including: traffic and congestion infrastructure, public and private transportation and so on.Note: teacher can introduce driverless cars as one solution to one of society’s problems.Transportation safely and volume if students are struggling with the concept. | Student workbook[Smart Cities: Solving Urban Problems Using Emerging Technology](https://www.youtube.com/watch?v=nnyRZotnPSU) |  |
| As above | As above | As above | Teacher* Shows students YouTube video ‘Anki oracle IoT Video’
* Explains IoT to give students an in depth understanding of what it is and how it’s meeting the needs of society.
 | [Anki Oracle IoT Video](https://www.youtube.com/watch?v=yZ85FsGA9lQ) |  |
| As above | As above | develop criteria to evaluate design ideas, processes and solutions, the functionality, aesthetics and a range of constraints, e.g. accessibility, cultural, economic, resources, safety, social, sustainability, technical(ACTDEP038, ACTDIP027, ACTDIP031) | Students* Develop their own design brief based on their chosen system.
* Think Pair Share through Realtime Board or padlet. These sharing platforms should be used while students are watching the videos to record their thoughts and observations.
* Analyse the design brief.
* Create a mind map of the Constraints.
* Set their Criteria for success.
 | [Realtime Board](https://realtimeboard.com/)[Padlet](https://padlet.com/) |  |
| As above | As above | collect and access data from a range of sources, for example: (ACTDIP025)evaluate the authenticity, accuracy and timeliness of data (ACTDIP025) | Students* Consider what sensors would need to be added to make the device ‘smart’.
* Use the internet in an attempt to categorize findings of the products related to IoT.
* complete research assignment set on IOT
* Keep a diary for a week to write down every time an electronic device helped make their life easier.
* Discuss whether these devices are or should be “smart” and communicate with each other.
* Use assignment to pick their favourite/least favourite product and print them out.
* Play the game ‘The Cool Wall’ where they use their printed product to place it on a whiteboard scaled from ‘useless’ to ‘cool’. Students are to explain their reasoning for the product scale and the class can agree/dispute their reasoning with explanation.
* Collate the data from each team member’s diary into a spreadsheet then create a graph that visualises the amount of time spent on devices.
 | Student workbook[Top Gear Cool Wall. Basis for LoT cool wall.](https://www.youtube.com/watch?v=-cO_8hWSUmg) |  |
| As above | As above | As above | Teacher* Leads discussion on our dependence upon electronic devices
* Asks students to think about how we survived before the internet of things?

Students* Write a paragraph describing the impact on the lives of people if all electronic technology suddenly stopped working.

OrCreate a ‘survival’ poster for what to do if the world was to go black. (for example – no access to any electronic device) | Student workbook activity |  |
| Weeks 3-5 | TE4-4DP | As above | TeacherShows the driverless car video.Note – at this point it is recommended to set up the track and allow the cars to ‘casually cruise’ around it, whilst the teacher shows the students the basis of what the oracle cars are capable of.Anki System* Unpacks the Anki Game
* Updates the firmware on the cars through the Anki Overdrive App on their smartphone.
* Demonstrates the Anki game (without the Raspberry Pi and Oracle hack at this point so comparisons can later be made)
 | [IoT Car](https://www.youtube.com/watch?v=_0cyl87HuCw)[Chris Urmson: Hwo a driverless car sees the road](https://www.youtube.com/watch?v=tiwVMrTLUWg)Teacher troubleshooting guide |  |
| As above | As above | As above | Students* Document how they believe this system works by answering questions in their Student workbook under ‘unpacking the game’
 | Student workbook |  |
| As above | TE4-10TS | explains how people in technology related professions contribute to society now and into the future | Teacher* shows the video ‘Under the hood’
* Establishes Real time board or Padlet for class interaction and sharing in real time.

Studentscomplete the worksheet questions in their student booklet | [Under The Hood](https://www.youtube.com/watch?v=1tmcHqIEfXQ)[Realtime Board](https://realtimeboard.com/index/) |  |
| As above | As above | As above | Teacher* Propose the scenario: what would it mean if the cars can communicate?
* Shows the YouTube video ‘IoT Car’
* Shows the YouTube video by Chris Urmson

Students* use Realtime board or Padlet to share ideas on ‘what might happen if cars talk to each other’
 | Student workbook and teacher solution book[Chris Urmson: Hwo a driverless car sees the road](https://www.youtube.com/watch?v=tiwVMrTLUWg) |  |
| As above | As above | As above | Teacher* Discusses and demonstrates each component of the Anki System including completion of workbook on the cars and track.
* • Shines a light through the track to reveal encoding.

Studentscomplete the cloze passage and labelling exercises from workbook | Student workbook and teacher solution book[Raspberry Pi](https://www.raspberrypi.org/) |  |
| As above | As above | explore how data is transmitted and secured in wired, wireless and mobile networks, for example: (ACTDIK023)how data is transferred over the internet with TCP/IP | HackingStudents* complete worksheets on the concept of Hacking

Teacher* Introduces
	+ ‘Hacking’ good and bad
	+ the Government funded and supported :Hack-a-thon: GovHack
	+ the Oracle Anki Hack
	+ leads discussion on network security
	+ Importance of public school network private

ExtensionCase studies on [Cybersecurity including Stuxnet](https://www.ted.com/talks/ralph_langner_cracking_stuxnet_a_21st_century_cyberweapon?language=en) | [Government backed Hack-a-thons](https://www.govhack.org/) |  |
| As above | As above | interpret and visualise data using a range of software to create information, for example: (ACTDIP026) | EncryptionStudents* Make their own Caesar Cipher from paper plates and encrypt and decrypt messages.

Extension* Students can create their own digital Caesar Cipher by coding it in Python.
 | [Caesar Cipher](https://cryptii.com/pipes/caesar-cipher)[How to make a cipher wheel](https://www.stemlittleexplorers.com/en/how-to-make-cipher-wheel/)[Python](https://trinket.io/python/5868d7f20c) |  |
| As above | As above | As above | NetworksTeacher leads class through each component of the Oracle Anki System including:* The Raspberry Pi
	+ And its use in multitudes of projects.
* Networks and Protocols
* Transmission mediums
* the Total flow js software
 | Oracle interface when connected and running the Raspberry PiInternet research |  |
| As above | As above | Producing and implementingplan and manage projects individually and collaboratively (ACTDEP039) | Students* Explain the Oracle Anki system using the Infographic and keywords
* Complete the labelling exercise on the Raspberry Pi components
* Watch the video on The Internet ,Wires, Cables and Wi-Fi
* Complete questions
* Play Tablets of Stone
	+ (Teachers print out and issue ‘tablets’)
* Use the command prompt to Ping the IP addresses of a website and discuss results.
* Watch the video on IP Addresses below to consolidate their understanding:
* The Internet IP Addresses and DNS
* Explain in their own words why IP addresses are so important to the Internet of Things.

(Teachers point out that each Anki car has a unique identifier which is its MAC address which is a hexadecimal number) | [The Internet .Wires, Cables and Wi-Fi Video](https://www.youtube.com/watch?v=ZhEf7e4kopM&feature=youtu.be&list=PLzdnOPI1iJNfMRZm5DDxco3UdsFegvuB7)[Network protocols](https://classic.csunplugged.org/network-protocols/) |  |
| As above | As above | Testing and Evaluatingevaluate how student solutions address defined functional requirements and constraints (ACTDIP031)  | Students* Work in teams to research the Transmission Mediums in their student workbook.
* Create an Infographic which depicts a score (out of five) for these medium based on Speed, Cost, Bandwidth, Distance, and Mobility.
* Each Infographic then forms part of a Trumps Card game.
* Play this game and record their results on the matrix provided.
 | [Making info graphic](https://www.canva.com/) |  |
| As above | As above | trace algorithms to predict output for a given input and to identify errors (ACTDIP029) | AlgorithmsStudents* Watch the video on Exact Instructions
* Write step by step instructions for making a piece of butter and vegemite toast: you may not need all spaces. Ask your friend to follow it (desk checking) and see if it works!

Teacher* Discusses pseudocode and flowcharts as text and graphic methods of representing algorithms

Students* Complete flowchart and pseudocode exercises.
 | [Exact Instructions Challenge](https://www.youtube.com/watch?v=cDA3_5982h8)Student workbook |  |
| As above | As above | Producing and implementingplan and manage projects individually and collaboratively (ACTDEP039)implement and modify programs involving branching, iteration and functions in a general-purpose programming language, for example: (ACTDIP030) | Teacher* Connects the Raspberry Pi with the Oracle Anki Image on its microSD card to the school network and opens the software.
* Organises class into 4 groups (one for each car).

Each group (or pit crew) has a role and or responsibility.Suggested roles:* Team Leader, (spokesperson and liaise with teacher and other teams.)
* Coder (writes the code in collaboration with team),
* Trouble shooter (Quality control, documents problems and solutions),
* Car Maintenance (monitors car on the track, cleans tyres and track).
* Recorder (filming , timekeeper) & Presenter

These roles should be rotated throughout the course of the challenges. Each team member contributes to the design of the algorithms and to the design and development of the Smart City solution. | Computer connection to Raspberry Pi (Ethernet or Wi Fi)Raspberry Pi with Oracle Anki image on micro SD card booted up for challenges.* Micro USB cable and micro USB charger
* HDMI to VGA adapter or HDMI cable
* Instructions for connecting to WIFI – teacher booklet , troubleshooting appendix
* Instructions how to connect the Raspberry Pi to the computer
 |  |
| As above | As above | Testing and Evaluatingevaluate how student solutions address defined functional requirements and constraints (ACTDIP031) trace algorithms to predict output for a given input and to identify errors (ACTDIP029)Students test the algorithm for their solution to determine their success | CodingStudents* program a simulation of the Anki Race car track using Trinket(On line Turtle for Python a readily accessible coding language between Scratch and Python proper:
* Complete all the Oracle coding challenges.
* Document their testing procedures in the student workbook
* Develop their own challenge.
* Offer their challenges to other teams to complete.
* Design and develop using a combination of challenges a coded solution to their l their Smart City problem.
* Build a model around the track (using milk cartons, Lego or timber blocks) to represent their Smart City and demonstrate their solution to the class.

Testing is recorded in the student’s portfolio in a results testing table where students are required to screen shot their block diagrams and specify improvements. | Teacher bookletSolutions appendixStudent workbook[Turtle Race](https://projects.raspberrypi.org/en/projects/turtle-race)Totalflow js software on Raspberry Pi14 Challenges in Student booklet and [Oracle Learning System](http://edu.opcau.com/)Milk cartons, Lego, timber blocks, model railway sets and so on. |  |
| Week 6 | TE4-7DI | As above | EthicsTeacher* Leads class discussion on an ethics training question to introduce the concept.

For example‘There is a runaway train travelling down the railway tracks. Ahead, on the tracks, there is a baby who has crawled onto the tracks. The train is headed straight for the baby. You are standing some distance off in the train yard, next to a lever. If you pull this lever, the train will switch to a different set of tracks. However, you notice that there are five people working on the tracks wearing full personal protective equipment. You have two options:Do nothing, and the train kills the baby.Pull the lever, diverting the train onto the side track where it will kill the workers.’Which is the most ethical choice? | Student workbook |  |
|  |  | identify social, ethical and cyber security considerations of digital solutions, for example | StudentsConsider whether they would purchase or use a driverless vehicle that would (faced with the decision of choosing to save its driver or a pedestrian) jeopardise the life of the driver?* Play the Moral Machine.
	+ Teachers are to view the contents of this site prior to sharing with class to determine appropriateness.
* Design their own scenario

Possible solutions could include all taking cars ahead of the vehicles communication to slow the traffic and avoid collisions.For example: a systems managed solution. | [The Moral Machine](http://moralmachine.mit.edu) |  |
|  |  | identify social, ethical and cyber security considerations of digital solutions, for example: | Teacher* leads discussion surrounding Social and ethical issues regarding data and its uses are discussed including:
	+ Facebook – nothing posted on FB is your own (goes for any social media)
	+ App permissions – access to microphone to tailor advertisements whilst online.
	+ Cambridge Analytica – although bankrupt, how many of these companies exist? Ethical application of data taken that has been posted publically.
	+ Microchipping (humans and animals) – Pros and cons (telemedicine, tracking children and so on)
* Co-ordinates a class debate on any one of the ethical subjects raised in the unit.
 | Student workbookComplete table |  |
| Weeks 7-9 | TE4-4DPTE4-10TSTE4-2DPTE4-1DP | evaluate how student solutions address defined functional requirements and constraints (ACTDIP031)investigate how digital systems represent text, image and audio with whole numbers, for example: (ACTDIK024)design algorithms that use a range of data types, branching and iteration and represent them diagrammatically and in English (ACTDIP029) | Students:* Complete final evaluations of their project.
* Present to class their Smart City solution

Once students have learnt the skills for how to control the cars students can complete in an interschool’s challenge through Oracles software. Challenges can include:* Fastest lap time
* How far the cars have travelled
* How much battery power has been used?

Note: racetrack will need to be configured specifically as outlines in the extension resource) | [Smart City video from Oracle Italy](https://www.youtube.com/watch?v=x2wMzMjsSGo)Historical car and track data(locate group ID)Registration Text on Oracle Anki Interface |  |
| As above | As above | As above | TeacherEnters registration details on the Oracle Anki Interface so cars data can be sent to the Oracle Cloud for analytics and race times | Historical car and track data(locate group ID)Registration Text on Oracle Anki Interface |  |
| Week 10 | TE4-1 DP | identify social, ethical and cyber security considerations of digital solutions, for example | Students* use the knowledge they have gained from this unit as well as conducting research to identify any social, ethical or cyber security issues relating to their problem and solution
* Present their problem and solution to their peers in their choice of presentation.

Presentations ideas can include:* Video
* PowerPoint
* Prezi
* Animation
* Write weekly evaluations as they progress through the project to identify any problems, solutions and ideas that they discover during the process.
 | Assessment task 2Student workbook |  |

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