INQUIRY BASED LEARNING

SYDNEY METRO PROJECT

Digital Support Team
NSW Department of Education

Contents

CHALLENGE 1: TRANSPORT AND THE COMMUNITY

Part 1: Digital expectations and appropriate behaviours

We are going to be using the internet and lots of technology to solve a problem. Let's talk about some of the appropriate behaviours that we should display when using any digital platform.

Below are behaviours that all digital citizens should adhere to. Why are they important? :

- Students communicate clearly, respectfully and with empathy
- Students use technology for civic engagement and to be a force for good
- Students prioritise time and activities online and offline
- Students know how to be safe online and create safe spaces for others.

Part 2: Introduction to driverless vehicles and design thinking

Autonomous vehicles' are emerging as a reality in Australia. But where, when and how is that going to happen?
Your challenge is to

"Investigate the viability of creating a driverless transportation system for your local community"

Is it appropriate? What are the benefits and challenges? and what recommendations could you make to your town planners?
You will also need to design an appropriate route as part of the project plan to demonstrate the benefits.

Tune in and watch the following videos to gain inspiration for your design project.

Inventions = crazy idea and lots of mistakes

An automated road trip

Planning for the future is a reality now

Part 3: Conducting research into the needs of the local community

We are going to investigate the benefits of a driverless transportation system. We will also identify what the community needs.

Let's start with trains

Step 1: Research the technology that is utilised in a driverless railway system.

- Are driverless trains better for the community? Why/Why not?
- What sorts of safety features do these systems have?
- How are these systems powered and are they environmentally sustainable?
- What cities across the world are using driverless trains? Why have they chosen to utilise driverless trains?
- How do they work?
- What are the advantages of driverless trains over other modes of transport?

Step 2: Formulate a range of survey questions about your new driverless vehicle system and think of who to ask.
You could use Microsoft or Google Forms to create a survey for your community. What features should be incorporated into a driverless transportation system? What sorts of features would make the journey more comfortable for passengers? Think about using people from a range of ages, social backgrounds, cultures, family structures and people with special needs.

Step 3: Research accessibility features that may be incorporated into a transportation system. Think about features that could be incorporated into your designs (for example, lifts, ramps, tactile tiles). You may want to research transportation systems from across the world to acquire more ideas.

Part 4: Summarise all the information that you have collected from your research and survey responses. Identify which ideas and suggestions are crucial for your project.

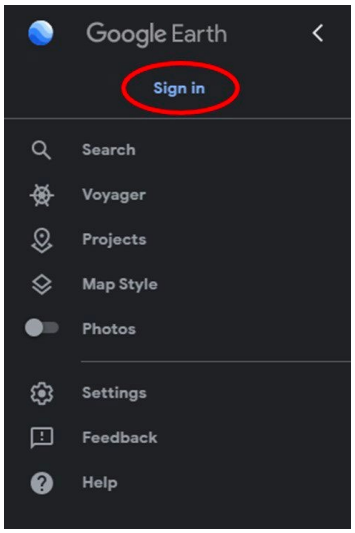
Is a train the best option for your town or something more mobile?

Contact your local council to see what transport plans they have. They might want to work with you on your ideas.

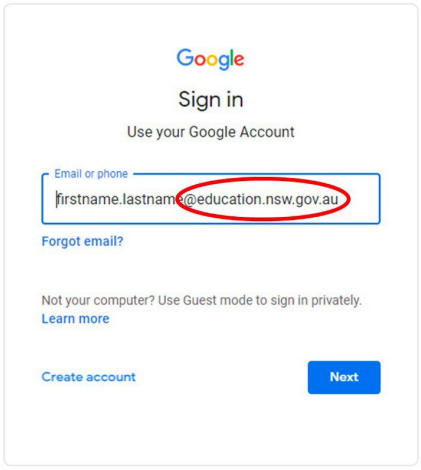
Part 4: Exploring Google Earth

Today, we are going to investigate the amazing features of Google Earth. This will prepare us for the next part of our learning challenge.

Step 1:
Open Google Earth using your web browser https://earth.google.com/web/ or in an App Ensure you are logged in using your Google credentials. (Picture 1 and Picture 2).

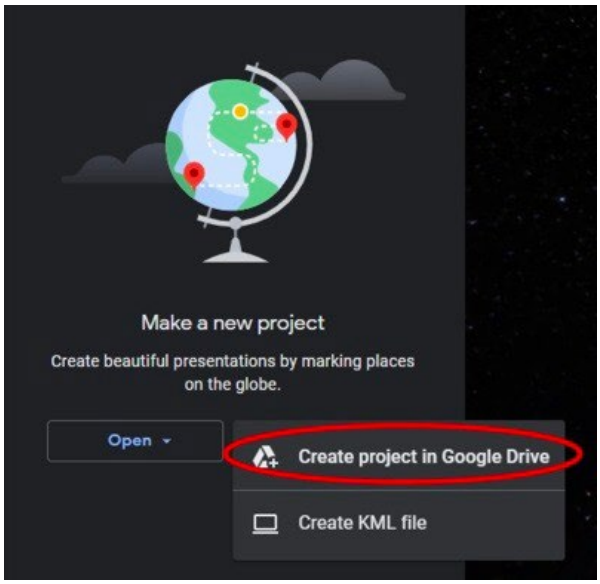


Picture 1



Picture 2

Step 2: Explore some of the features of Google Earth. Click on the button 'projects.' Select 'Create' and then 'Create project in Google Drive' (Picture 3). This feature will allow you to create a presentation within Google Earth (which can be saved into your Google Drive). It will also allow you to create a path (which will replicate the route of your transport network). You will look at this feature in greater detail later in learning challenge 2 but for now explore, the options.



Picture 3

Step 3: Search for a particular location that you think may benefit from a driverless transportation system. Investigate this location and see if a driverless vehicle transport system would be feasible. Alternative task:
Use the same process to create a driverless railway system for a regional attraction such as a zoo or nature reserve.

Step 4: Search for a particular location that you think may benefit from a driverless transportation system. Investigate this location and see if a driverless vehicle transport system would be feasible. Alternative task:
Use the same process to create a driverless railway system for a regional attraction such as a zoo or nature reserve.

Picture 4

Part 5: Reflection

Use the following questions to reflect on your work:

- What needs to be considered before placing a track and station?
- What did you find in your research or survey that surprised you?
- What potential issues could arise from the construction of a driverless transit system?
- What are the limitations?

In summary - **Is a train the best option for your town or something more mobile?**

CHALLENGE 2: PLANNING AND DESIGNING YOUR SYSTEM

Part 1: Planning a solution

Using the data we have collected in challenge 1, we are going to start planning our track/station/pickup design.

Step 1: Before we start designing our driverless railway system or station, we need to compile the data and information we have collected from the previous challenge, summarise key information and data, and use it to inform our planning in this challenge.

Step 2: Decide whether you will create a whole track design or a pick up station design. Whichever option you choose, accessibility for all people should be one of the key components of your design.

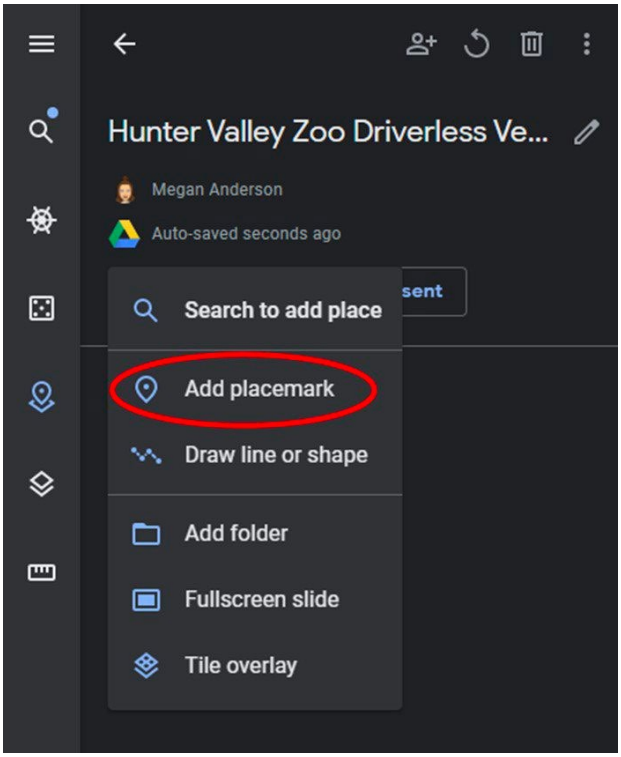
Step 3: Sketch your design ideas. You could use pencil and paper. Alternatively, you could use an application like Sketches School or SketchUp for Schools to record your ideas.

Part 2: Using Google Earth

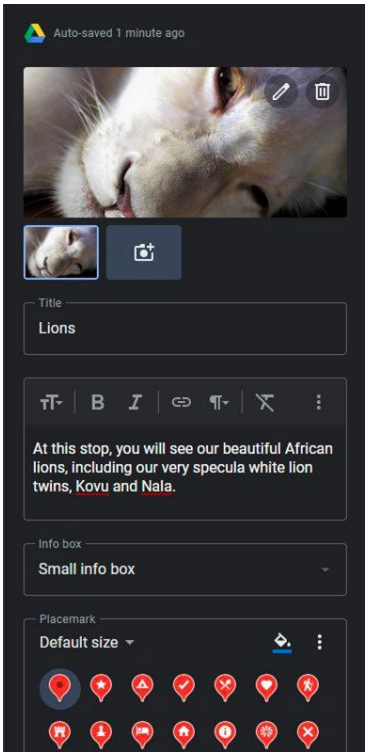
Step 1: Use Google Earth to investigate a suitable route for your driverless transport system. Think about population growth or the construction of a major infrastructure project (for example, Western Sydney Airport). Identify multiple routes that could be used. Use the measurement tools in Google Earth to measure how long your route will be. Think about how each route you create will impact on the surrounding environment and how it will impact local stakeholders. If in a regional area, what attraction could benefit from a driverless railway system with a dedicated track (for example, a zoo or nature reserve)?

Step 2: Discuss some of the issues and questions that may emerge when constructing a driverless railway system. Why would one station location be better than another? What implications would construction have on various stakeholders, for example, important Aboriginal Lands, resident locations, etc. Record some of these challenges or questions and propose positive actions to address them, when designing your driverless transport system.

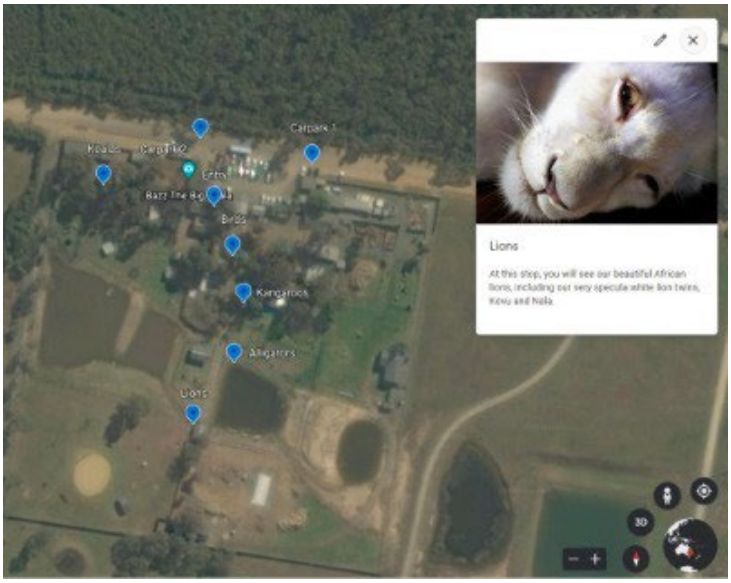
Step 3: Use the 'Project' tool to create your final route. You will need to 'Add Placemark' for each proposed station or important feature (Picture 5). Then you will need to create a card that gives your viewer important information about your transportation system or station (Picture 6). When completed, your audience will be able to see your card when the placemark is selected (Picture 7).



Picture 4



Picture 5



Picture 6

An idea - You could you capture a copy of your route on a large sheet of paper (to use as a floor plan).

You could put it up onto a digital display and enlarge and trace it.

Part 3: Designing the solution

Part 1: Use a design application to showcase your delivery solution. You could use Minecraft, CoSpaces or similar application to design your solution. You could even 3D print your design using Tinkercad (or similar application) or make it out of real-world objects.

Design your track, route or station and how it will look. Don't forget to consider aspects of design such as accessibility and environmental sustainability.

Alternative: If working in small groups, students could be allocated a particular role. These roles could include:

- Track designer
- Station designer
- Accessibility coordinator
- Sustainability coordinator
- Marketing coordinator
- Cultural coordinator

Part 4: Reflection

Use the following questions to reflect on your work:

- Why did you decide on this route and these stations?
- What changes do you need to make and how difficult is this going to be?
- Discuss your thoughts on the design thinking process. Why is it necessary to keep seeking feedback and improving your design? When else have you had to use the persistence and resilience required when designing? How do you solve problems?

CHALLENGE 3: CREATING YOUR PROTOTYPE

Part 1: Designing your course

We are going to design a model of your driverless transportation system using a Dash or similar robot. This will become your prototype to model your concept to others.

Step 1: Identify an open space to create your course. A classroom free of desks or school hall would be ideal.

Step 2: Incorporate a range of obstacles for your driverless vehicle to move around (for example, a drink bottle could represent a tower). These can be scattered across your course. or use your paper plan if you created one.

Step 3: Using cardboard or paper, mark out a track/ route for your Dash to travel along. Ensure that your Dash will have plenty of room to manoeuvre through the course (especially when making turns).

Step 4: Incorporate stations/ pick up points into your transportation system. What could you create to represent your stations? Make them 3D if you can.

Part 2: Coding and debugging

Step 1: Using the Blockly application, code your way through the track.

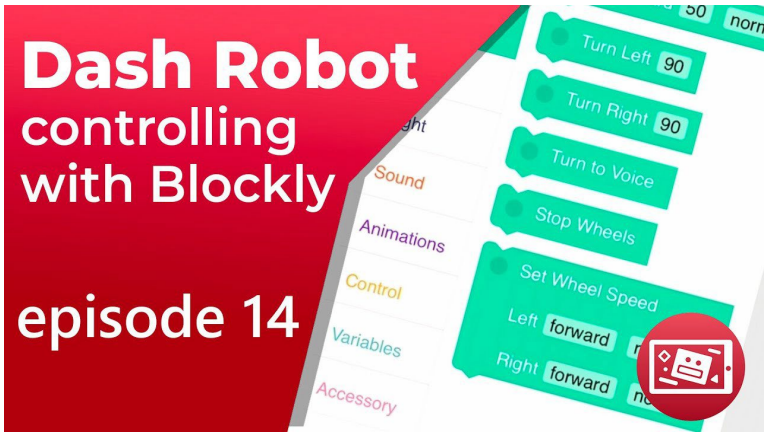
Step 2: Ensure your coding allows your vehicle to stop at the stations/ pick up points you have built. Your vehicle should allow a specific amount of time to stop at each station (enough for passengers to enter and leave the train). What could be the timetable for your system?

Step 3: Include a safety mechanism in your coding that allows the vehicle to stop if there is an obstacle in the way. This would be a crucial feature in a real driverless vehicle .

Step 4: Test your code at regular intervals to ensure that it is working correctly. Debug any errors that you come across.

Dash Robot Features

Dash Robot - Controlling with Blockly



Part 3: Reflection

Use the following questions to reflect on your work:

- What was the most challenging aspect of creating and coding your driverless transportation system?
- What changes did you need to make during the design process?
- What are some of the issues that could arise when designing and constructing a real driverless transportation system?
- Based on your research and designs, why do you think driverless transportation system are being implemented in more locations?

MAIN CHALLENGE:
DELIVERING YOUR DESIGN SOLUTIONS TO THE COMMUNITY

Part 1: Presenting your research and design

We are going to present our driverless transportation system designs and solutions to community members and stakeholders.

Step 1: Showcase your research to community members in a manner that suits you and/or your team. You could showcase your Minecraft or CoSpaces designs in a school forum such as a design show. You could also present your driverless railway system using a range of platforms such as Canva, PowerPoint, Keynote or Google Slides. Have a think about who else could offer input to your project, or might be interested in your work, and invite them. Perhaps someone from the local community, an employee from the local attraction, a member of the AECG, or a member from the local council.

Step 2: Present your driverless transportation system for other students to see. Present the findings from your survey. Answer questions that students or community members may have about your driverless transport system.

Part 2: Testing a community forum

Test out a community forum with your class using De Bono's thinking roles. Allocate roles to different groups of students.

Each group can discuss their thoughts on the driverless transport project. Groups could design a presentation based on their perspective of the project.

Test out the tricky questions and make sure you have answers because you are taking the ideas to your council.

Role	Focus
Logic	The facts
Optimism	The value and the benefits
Devil's advocate	The difficulties and dangers
Emotion	Feelings and intuitions
Creativity	Possibilities and new ideas
Management	Ensuring the rules of the hats are observed

Part 3: Collecting feedback and taking it to council

Ensure you seek feedback on your design and make changes accordingly. Using a tool such as Google or Microsoft Forms can assist you in compiling feedback on your design project from other students or the community.

Now contact your local council and organise a time with the town planners to share your ideas. Be prepared and professional because your council may not build your system but it will plant ideas and maybe even present some of the issues the people in your area have of moving from place to place.

TEACHER NOTES

Syllabus Outcomes

Mathematics Outcomes Stage 2	
MAO-WM-01	• Develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly
MA2-GM-02	• Measures and estimates lengths in metres, centimetres and millimetres
MA2-GM-03	• Identifies angles and classifies them by comparing to a right angle
MA2-GM-01	• Uses grid maps and directional language to locate positions and follow routes

Mathematics Outcomes Stage 3	
MAO-WM-01	• Develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly
MA3-GM-02	• Selects and uses the appropriate unit and device to measure lengths and distances including perimeters
MA3-3DS-01	• Visualises, sketches and constructs three-dimensional objects, including prisms and pyramids, making connections to two-dimensional representations
MA3-GM-03	• Measures and constructs angles, and identifies the relationships between angles on a straight line and angles at a point

Mathematics Outcomes Stage 4	
MAO-WM-01	• Develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly
MA4-DAT-C-01	• Classifies and displays data using a variety of graphical representations
MA4-ANG-C-01	• Applies angle relationships to solve problems, including those related to transversals on sets of parallel lines

Science and Technology Outcomes Stage 2	
ST2-1WS-S	• Questions, plans and conducts scientific investigations, collects and summarises data and communicates using scientific representations.
ST2-2DP-T	• Selects and uses materials, tools and equipment to develop solutions for a need or opportunity.
ST2-3DP-T	• Defines problems, describes and follows algorithms to develop solutions.
ST2-11DI-T	• Describes how digital systems represent and transmit data.

Science and Technology Outcomes Stage 3	
ST3-2DP-T	• Plans and uses materials, tools and equipment to develop solutions for a need or opportunity.
ST3-3DP-T	• Defines problems, and designs, modifies and follows algorithms to develop solutions.
ST3-11DI-T	• Explains how digital systems represent data, connect to form networks and transmit data.

Design and Technology Outcomes Stage 4	
DT4-1	• Identifies and describes a range of design concepts and processes.
DT4-2	• Describes and follows a process of design when developing design ideas and solutions.
DT4-6	• Identifies creative, innovative, and enterprising design ideas and solutions.
DT4-7	• Communicates design ideas and solutions using a range of techniques.

Geography Outcomes Stage 2	
GE2-1	• Examines features and characteristics of places and environments.
GE2-2	• Describes the ways people, places and environments interact.
GE2-3	• Examines differing perceptions about the management of places and environments.

Geography Outcomes Stage 3	
GE3-1	• Describes the diverse features and characteristics of places and environments.
GE3-2	• Explains interactions and connections between people, places and environments.
GE3-3	• Compares and contrasts influences on the management of places and environments.

Geography Outcomes Stage 4	
GE4-1	• Locates and describes the diverse features and characteristics of a range of places and environments.
GE4-2	• Describes processes and influences that form and transform places and environments.
GE4-3	• Explains how interactions and connections between people, places and environments result in change.
GE4-4	• Examines perspectives of people and organisations on a range of geographical issues.
GE4-5	• Discusses management of places and environments for their sustainability.

Challenge overviews

Mini Challenge 1 -	Mini Challege 2 -
Formative assessment • Formative assessment will take place throughout the planning process. Summaries of student findings including data from surveys will be the basis of assessment in mini challenge 1. Learning intentions • We are learning about driverless vehicles and how they assist citizens. • We are learning about how driverless trains utilise various technologies to operate successfully. • We are learning about how the construction of a driverless railway can impact on stakeholders in the community. • We are learning to use some of the features of Google Earth. • We are learning about accessibility and why it is important when designing infrastructure. Success criteria We will be successful if we can: • Clearly articulate the advantages and disadvantages of driverless railway systems. • Identify the needs of the community through the use of digital surveys. • Outline the accessibility requirements for a driverless railway in any future projects. Learning activities • Digital expectations and appropriate behaviours. • Tuning in activity - How can driverless vehicles benefit society? • Introduction to driverless vehicles and design thinking. • Conducting research and understanding the needs of the local community. • Exploring Google Earth. • Reflection Preparing for the challenge • Build up background knowledge about driverless vehicles from around the world. How have they contributed to cities and regions?	Formative assessment • Formative assessment will take place throughout the duration of this part of the learning challenge. Designs on multiple digital platforms can be utilised as assessment items (for example. route planning using Google Earth, Station design using Minecraft, etc). Learning intentions • We are learning to sketch and design our driverless railway system. • We are learning to use Google Earth to plan out the route of our driverless railway system. • We are learning to use a digital platform to plan our digital system. • We are learning to reflect on our designs and make alterations throughout the design process. Success criteria We will be successful if we can: • Plan, devise and present a route for your driverless vehicle using Google Earth. • State why a particular route is preferred (e.g., the route requires less destruction of the local environment). • Create a driverless railway system or station design that is accessible by all community members. • Utilise feedback from mini challenge 1 to influence our designs. Learning activities • Planning a solution. • Using Google Maps to design an appropriate route. • Designing the solution. • Reflection. Preparing for the challenge • Think about how a driverless transit system could benefit your local community. Where would be a suitable location for a driverless transit system? Where would your track go?

Challenge overviews

Mini Challenge 3 -	Main Challenge -
Formative assessment • Formative assessment will occur throughout the building and coding process. Evidence of coding and debugging can be used as artefacts for assessment. You could also assess the complexity of the course that students create and navigate. Learning intentions • We are learning to use coding to create a model of a driverless transportation system. • We are utilising measurement and geometry to create a driverless transportation system. • We are learning to debug our code to ensure that it works correctly. Success criteria We will be successful if we can: • Create a driverless transportation system using Dash or similar robotic system. • Incorporate multiple automatic station stops throughout the system. • Utilise angles and distance when designing the code for the driverless transportation system. • Use the sensors on the Dash to engage an emergency stop. Learning activities • Designing your course • Coding and debugging • Reflection Preparing for the challenge • Ensure students have a basic understanding of Dash (or other similar robot). They should be able to utilise the basic functions of the Blockly application in order for them to navigate their driverless railway track.	Formative assessment • Formative assessment will be undertaken throughout the learning challenge. Student presentations can be used as an assessment artefacts. Learning intentions • We are learning to use digital technologies to present a solution to community members and stakeholders. • We are learning to present our research and solutions in an informative and engaging way. Success criteria We will be successful if we can: • Present our driverless railway system to the community and stakeholders. • Present our research and solutions using a digital platform (Canva, Power Point, Keynote, Slides, etc) • Answer questions and queries put forward by community members and stakeholders. Learning activities • Presenting your research and design • Community forum (optional) • Collecting feedback Preparing for the challenge • Students should have a sound knowledge of a digital platform that allows them to showcase their findings (e.g. Power Point, Keynote, etc).

Unit Information

Driving Questions:

- What are the benefits of driverless vehicles?
- How can driverless vehicle technology be applied across a range of contexts?
- Can we design a driverless vehicle solution?

5P Process for Planning

Problems	Passions	People	Places	Projects
What problems do students have with this topic?	what passions in general, when learning, about this topic	what people could you tap into to help you with this project and topic?	what places could you visit (physically or through virtual links) as you complete this topic?	List a number of possible projects that could be done.
• What are the benefits of driverless trains to society? • How can driverless vehicle technology be applied across several contexts? • Can we design a driverless vehicle solution?	• Passion about designing driverless vehicle solutions. • People who are empathetic to the needs of a range of stakeholders e.g. indigenous communities, people with disabilities, the elderly, etc.	• Indigenous community members. • Representatives from driverless vehicle projects. • Stakeholders that may be impacted from a transport solution. • Engineering staff. • University staff. • Construction workers. • Community members. • Western Sydney Airport stakeholders.	• Conversations with project staff. • Virtual excursions to worksites. • Q and A sessions with stakeholders (e.g., engineers, construction staff, etc).	• Design solutions can be created across several digital platforms including (but not limited to): • CoSpaces • Minecraft • Dashbot and Blockly app • Canva • Power Point • Google Slides.

Marking criteria

Concerns How do we know we need to do better?	**Criteria** How do we know when we have done well?	**Advanced** How do we achieve above expectations?
Research and Presentation		
There is limited evidence of research into possible solutions	Research is evident and gives the audience a sound understanding of the problem and possible solutions. The research has been compiled into a presentation that is engaging and informative.	In-depth research is evident about the problem and possible design solutions. The research gives community members and stakeholders a deep knowledge of the project. The student has developed an innovative and highly engaging presentation.
Google Earth Presentation		
Google Earth presentation contains basic information that lacks detail and elaboration. Limited cards have been used to describe the route of the transportation system. Few images have been incorporated into the cards.	Google Earth presentation is informative and delivers details about the route of the driverless transportation system. Images have been incorporated into the cards that have been developed. Cards include information on future stations associated with the transport system.	Google Earth presentation is exemplary and contains in-depth information about the driverless transportation route. Images have been incorporated into the cards that have been developed. Cards include information on future stations and other important features of the system.

Station or track design using Minecraft or CoSpaces		
Station or track design shows some evidence of planning and care. Student has incorporated some accessibility or sustainability features in the track/station design. Student can explain the key features of their design in some detail. Design may be incomplete or missing important features.	Station or track design neatly presented in chosen platform. There is evidence of careful planning. Station or track design contains accessibility and sustainability features (e.g., wheelchair accessibility, solar panels, etc). Student can explain the key features of their design to another person.	Student has demonstrated a high level of care and attention to detail when designing their station or track. Innovative ideas have been incorporated within the design (e.g., coding has been enabled to enhance the design, Tour guide in Minecraft, etc). Station or track design contains accessibility and sustainability features (e.g., wheelchair accessibility, solar panels, etc). Student can clearly explain the key features of their design to another person.
Dashbot track design		
Track design is basic and may include one stop. Coding doesn't allow the train to be fully automated. Emergency stop feature has not been incorporated into the coding. Project may be incomplete.	Track design contains multiple stops and is fully automated. Evidence of planning and effort are evident. Emergency stop feature has been incorporated into coding. Students can briefly explain how their coding works and can answer questions sufficiently.	Track design contains multiple stops and is fully automated. Track and coding design is more advanced in complexity (e.g. the train alternates automatically between two different routes,) Evidence of intricate planning and effort are evident. Emergency stop feature has been incorporated into coding. Students can explain how their coding works in great detail (using correct terminology) and can answer questions confidently.