

Metro Minds Innovation STEAM Challenge unit

Class: Starting date: Duration: Lesson length: Lesson frequency:

By participating in this unit students will have the opportunity to apply their subject area skills and knowledge in a real-world situation via the design thinking process.

Unit context: This unit was written by James Phelps, Minds Wide Open on behalf of Sydney Metro as part of its education program and schools competition - the Metro Minds STEAM Challenge. Metro Minds STEAM Challenge invites students in Year 7 to Year 10 from Sydney's city and south west area to work together to come up with an innovative solution to an authentic Sydney Metro challenge or opportunity using the design-thinking process.

Focus learning areas or strands

- Design and Production (DP)
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Rationale for this unit (Problem statement)

"PISA tests reveal that significant numbers of 15-year-olds do not have the basic problem-solving skills considered necessary to succeed in today's – let alone tomorrow's – world" (PISA in Focus, N38, 2014).




Teacher's driving question

How can I assist my students to find and solve a worthwhile problem (related to the Sydney Metro) so they have an opportunity to practise the design thinking process while applying subject area knowledge/skills?

General capabilities

 CCT 
 ICT 
 Personal & Social 
 Ethical Understanding 
 Intercultural Understanding 
 Literacy 
 Numeracy 

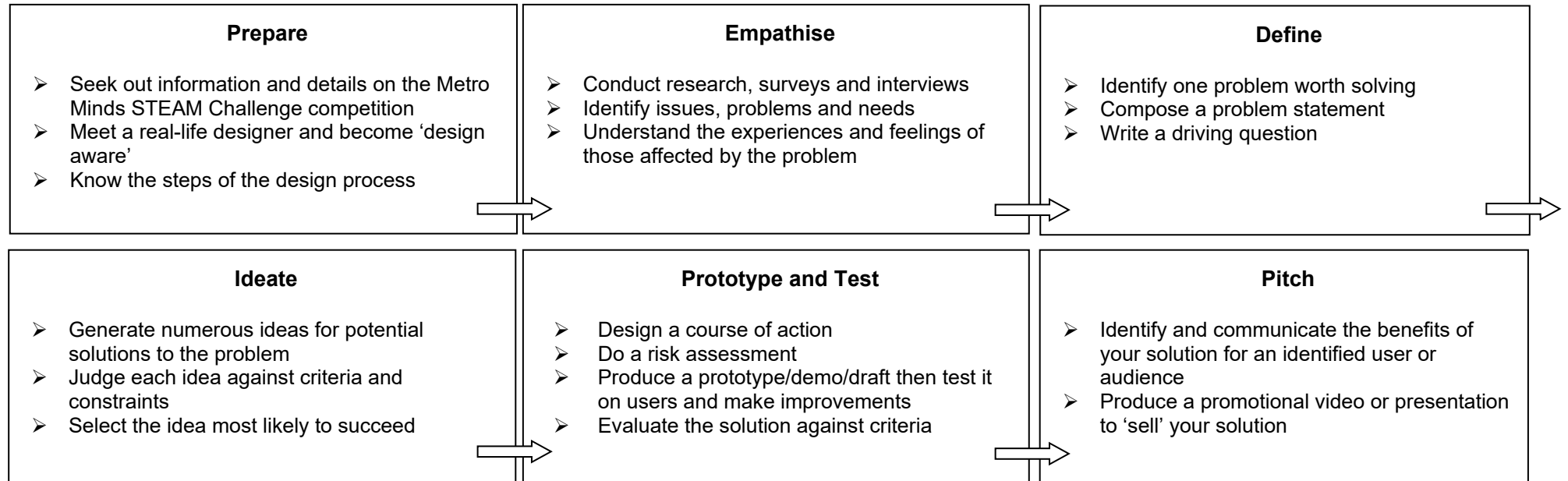
Cross curriculum priorities




 Aboriginal and Torres Strait Islander histories and cultures 
 Asia and Australia's engagement with Asia 
 Sustainability 






Learning objectives (NESA)



1. That students develop knowledge and understanding of the role of people and technologies in developing innovative solutions for preferred futures.
2. That students value the development of design skills and gain satisfaction from their use to solve problems and create quality products.
3. That students develop and apply skills in project management and evaluation when designing and producing solutions.





Unit overview and learning sequence













Project Phase	Stage 4 Learning Outcomes	Stage 5 Learning Outcomes	Thinking and learning activities for students (Teacher's script)	Teaching Resources	Register
<p>PREPARE</p> <p>During this phase students will:</p> <ul style="list-style-type: none"> - gain information on, and inspiration from, the Metro Minds Innovation STEAM Challenge - listen to an expert designer describe their work - view an 'explainer' video to gain an overview and general understanding of the design process and how designers think - reflect on and identify personal abilities, talents and strengths (related to the project domain or subject area) which could be utilised in the project - form diverse multi-disciplinary teams 	<p><i>TE4-10TS explains how people in technology related professions contribute to society now and into the future</i></p> <p><i>DT4-3 describes the impact of past, current and emerging technologies on the individual, society and environments</i></p> <p><i>DT4-1 identifies and describes a range of design concepts and processes</i></p> <p> <i>analyses personal characteristics and skill sets</i></p> <p> <i>makes a realistic assessment of their abilities and achievements</i></p>	<p><i>DT5-4 analyses the work and responsibilities of designers and the factors affecting their work</i></p> <p><i>DT5-3 evaluates and explains the impact of past, current and emerging technologies on the individual, society and environments</i></p> <p><i>DT5-1 analyses a range of design concepts and processes</i></p> <p> <i>assesses their strengths and challenges and devises personally appropriate strategies to achieve future success</i></p>	<p>WHAT IS THE METRO MINDS STEAM CHALLENGE? View video: Metro Minds STEAM Challenge 2024 Recap the main points from the video. Research. Individually explore the Metro Minds website to gather more details about the competition. Identify key information relevant to students – eligibility, deadlines, assessment criteria, prizes etc</p> <p>WHAT DOES A 'DESIGNER' DO? (Guest speaker _____) Listen to an expert designer describe their work processes and show some of their designs. View videos - <i>Designing Sydney Metro's New Stations</i> (4 mins) and <i>Noise Minimisation Innovation at Martin Place</i> (2 mins) Class discussion <i>What were the <u>problems or needs</u> that lead to the designer's solution?</i> <i>Speculate how the designer <u>came up with the idea</u> for the solution?</i> <i>What were some of the <u>technologies</u> used during the project?</i> <i>What are some ways that this designer's work will <u>make an impact</u> on customers, society and the environment now and into the future?</i></p> <p>HOW DO DESIGNERS THINK? Display and read the Metro Minds design thinking process poster. View: <i>The design thinking process</i> (4 mins) Recall the five phases of the design process and write a general description of what happens during each phase.</p> <p>WHAT AM I GOOD AT? Reflect and self-assess Consider questions on the MIPAC, relating your answers to either the subject area (that is, the class you are in now) or to STEAM skills in any domain.</p> <p>WHO IS IN MY TEAM? Discuss and challenge the idiom: 'Great minds think alike'. What might be some of the disadvantages of being in a team whose members all think alike and who have similar skills and interests? 30 second pitch: Tell the class the skills and expertise that you would bring to a design team and how you could be an asset. Negotiate: Students organise themselves into multidisciplinary teams comprised of members with diverse interests and passions.</p>	<p>https://youtu.be/zcJfNXnH-hs</p> <p>https://www.sydneymetro.info/metro-minds-steam-challenge</p> <p>https://www.youtube.com/watch?v=dzYlLnGf_bo&feature=youtu.be</p> <p>https://www.sydneymetro.info/sites/default/files/document-library/Metro_Minds_design_thinking_process_poster.pdf</p> <p>https://youtu.be/r0VX-aU_T8?si=5PKUO2T55CV6dm-n</p> <p>https://www.studenthandouts.com/graphic-organizers/processes/five-steps-flow-chart-diy-printable.html</p> <p>'MIPAC' student worksheet from <i>Minds Wide Open</i> https://static1.squarespace.com/static/57494dc1746fb940f107da0e/t/5cc8f0b1fa0d603a573600ac/1556672702261/mipac-7-10.pdf</p>	



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<p>EMPATHISE During this phase students will:</p> <ul style="list-style-type: none"> - consider different ways in which an individual, the community or the environment might be impacted by changes from the new Sydney Metro in the local area - conduct research, surveys and interviews - inquire of the experiences and feelings of others - identify a problem worth solving 	<p> <i>acknowledges the values, opinions and attitudes of different groups and compares to their own points of view</i></p> <p> <i>poses questions to probe assumptions and investigate complex issues</i></p> <p> <i>collects, authenticates and interprets data from a range of sources to assist in making informed judgements</i></p>	<p> <i>poses questions to critically analyse complex issues</i></p> <p> <i>defines and decomposes complex problems in terms of functional and non-functional requirements</i></p>	<p>Appoint a 'scribe' for your group to write answers and record your team's thoughts on the EMPATHISE page of the <i>Metro Minds STEAM Challenge Project Guide and Design Folio</i> (in either a soft or hard copy form).</p> <p>WHO ARE OUR POTENTIAL CUSTOMERS/CLIENTS OR END-USERS?</p> <p>In your group, discuss and identify members of the public who would have different viewpoints to your own. List a range of Sydney Metro user groups in your community, or people working on the Metro, then select who you will survey, interview, observe or research.</p> <p>WHAT DO OUR CUSTOMERS/CLIENTS OR END-USERS NEED?</p> <p>To gather and record information from several perspectives you are to:</p> <ol style="list-style-type: none"> 1. design a survey and/or write a series of questions for an interview 2. select questions that you think will best elicit opinions, wants and needs from the participants 3. conduct your survey/interviews and collate and analyse the responses <p>(Examples of some responses from surveys and interviews: <i>Whenever I try to drop off or pick up my daughter near the station the kiss and ride space is taken up by people parking there for too long.</i> <i>My parents would use the trains more but without English skills they worry about catching the wrong train or getting off at the wrong station.</i> <i>I am a senior citizen and I have difficulties with modern ticketing systems.</i> <i>I would use public transport more often except I worry about the high risk of catching and spreading viruses.</i> <i>I am concerned about a lack of etiquette that I see in some commuters which affects me and customers' travel experiences.</i> <i>I know I should help the planet by using public transport more often but I like the convenience of my car too much.)</i></p> <p>List some important issues, problems or needs that you discovered from your research. Describe how user groups are affected by the problem and identify specific wants or needs and/or any hopes or aspirations that they might have. Select the problem that members of your team agree is the most worthwhile one to solve.</p>	<p>Metro Minds STEAM Challenge Project guide and design folio for students – EMPATHISE page</p> <p>https://www.sydneymetro.info/sites/default/files/document-library/Metro_minds_design_folio.pdf</p>	

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<p>DEFINE During this phase students will:</p> <ul style="list-style-type: none"> - analyse the problem - compose a problem statement - write a driving question 	<p> explains needs, opportunities or problems and defines them in terms of functional requirements and constraints</p>	<p> defines and decomposes complex problems in terms of functional and non-functional requirements</p>	<p>Appoint a 'scribe' who will write answers to questions on the DEFINE page of the <i>Metro Minds STEAM Challenge Project Guide and Design Folio</i>. Work through the questions together to deconstruct the problem and define it in a clear problem statement and simply-worded driving question (aka a design challenge).</p> <p>HOW DO WE COMPOSE A PROBLEM STATEMENT?</p> <p>Discuss the purpose of a problem statement? <i>A problem statement clearly describes the problem your project will address. Without a problem statement the project's goal will be vague.</i></p> <p>Break down the problem (that you selected in the EMPATHISE phase) by asking three questions: What is the issue? Who or what is affected by it? How are they negatively impacted by the issue?</p> <p>Draft your problem statement in the DEFINE section of your project guide and check it against the listed criteria.</p> <p>HOW DO WE WRITE A DRIVING QUESTION?</p> <p>Read the DQ definition and exemplars on the DEFINE page then come up with your own definition for a driving question. Discuss the DQs purpose in a project. <i>(A driving question is a design challenge explained in one sentence. It does not state how you will solve the problem.)</i></p> <p>Re-read your problem statement then experiment with different wordings by saying out loud "How can we...?" while inserting and substituting different verbs from the list on the DEFINE page. Play with the wordings and explore several options until your driving question has a similar structure to the exemplars.</p> <p>Write three different draft DQs. Select your best DQ and tweak and re-write it, checking it meets the criteria.</p> <p>Create a cool poster with your driving question on it and display it on the classroom wall (for the entire duration of the project).</p>	<p>Metro Minds STEAM Challenge Project guide and design folio for students – DEFINE page</p> <p>https://www.sydneymetro.info/sites/default/files/document-library/Metro_minds_design_folio.pdf</p>	

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<p>IDEATE</p> <p>During this phase students will:</p> <ul style="list-style-type: none"> - identify 'brainstorming' techniques used by designers - generate and record their own original ideas - communicate their design ideas - evaluate their ideas against a criteria for success - choose their most original and practicable idea for implementation 	<p>TE4-1DP designs and communicates innovative ideas and creative solutions to authentic problems or opportunities</p> <p> explores situations using creative thinking strategies to propose a range of alternatives</p> <p>DT4-7 communicates design ideas using a range of techniques</p> <p> predicts possible outcomes when putting ideas into action</p>	<p>DT5-7 uses appropriate techniques when communicating design ideas and solutions</p> <p> generates original ideas in two-dimensional representations using a range of technical drawings</p> <p> evaluates their solutions in terms of risk, sustainability and potential for innovation</p>	<p>HOW DO DESIGNERS GET IDEAS?</p> <p>Class discussion Observe a group brainstorming session. At the end of the video we will answer and discuss these three questions:</p> <ul style="list-style-type: none"> - What was the problem statement? - What was the driving question? - What were some techniques that the leader used to help his team brainstorm better? <p>View video by IDEO-U: <i>Brainstorming at IDEO</i> (2 mins)</p> <p>Write In your project book write the six rules of brainstorming according to IDEO: 1. Defer judgement 2. Encourage wild ideas 3. Build on the ideas of others 4. Stay focused on the problem 5. Be visual 6. Go for quantity</p> <p>HOW DO WE RUN A BRAINSTORMING SESSION?</p> <p>Place your poster of the driving question in the middle of your group and constantly refer to it during your ideation session. Using your imagination generate and record a diverse range of original ideas (write or draw them on post-it notes or whiteboards). Apply the 6 brainstorming rules of IDEO to help your group come up with a long list of possible (and impossible) solutions.</p> <p>(Photocopy extra pages of the IDEATE page from the <i>Metro Minds STEAM Challenge Project Guide and Design Folio</i>. Nominate the best writer / best sketch artist from the group to be the scribe for the IDEATE page.)</p> <p>Select at least four ideas from your brainstorming session that you think might have potential. Have your group's scribe describe and/or illustrate these ideas in more elaborate detail in the project guide. Work through the ideas one by one, identifying each one's pros and cons by carefully and methodically following the steps outlined in the project guide.</p>	<p>https://www.youtube.com/watch?v=WIVlACbAWIo</p> <p>Metro Minds STEAM Challenge Project guide and design folio for students – IDEATE page</p> <p>https://www.sydneymetro.info/sites/default/files/document-library/Metro_minds_design_folio.pdf</p>	

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<p>PROTOTYPE During this phase students will:</p> <ul style="list-style-type: none"> - Identify the processes and materials needed to produce their designed solution - do a risk assessment - write an action plan - produce a demo, 3D model or beta version of their designed solution 	<p><i>TE4-2DP plans and manages the production of designed solutions</i></p> <p> <i>devises strategies and formulates plans to assist in the completion of challenging tasks</i></p> <p> <i>outlines the details and sequence in a whole task and separates it into workable parts</i></p> <p> <i>identifies the steps involved in planning the production of designed solutions</i></p> <p><i>TE4-3DP selects and safely applies a broad range of tools, materials and processes in the production of quality projects</i></p>	<p> <i>develops detailed project management plans incorporating elements such as sequenced time, cost and action plans to manage a range of design tasks safely</i></p> <p> <i>applies management plans, changing direction when necessary, to successfully complete design tasks</i></p>	<p>HOW DO WE MAKE A PLAN FOR OUR PROTOTYPE?</p> <p>In section 4 of your project guide list the resources - tools, instruments, materials or digital technologies - that you will need in order to produce or implement your solution.</p> <p>Predict and troubleshoot In your project guide write a simple risk assessment and identify any potential risks or hazards and describe preventative measures you will put in place do reduce risk or remove the hazards.</p> <ul style="list-style-type: none"> - Identify any possible risk of accident or injury to yourself during the implementation of your plan. - Explain how you will prevent accidents or injuries from occurring. <p>Make predictions and make decisions Think through and write down all of the steps that your group will need to take to 'bring your idea to life'. Complete the Action Plan template in your project guide by responding to these questions with detailed answers:</p> <ul style="list-style-type: none"> - What action is to be taken? - Who is responsible for this action? - How will it be achieved? - Where will this action take place? - When is this step due to be completed? <p>CAN WE PUT OUR IDEA INTO ACTION NOW?</p> <p>Execute your plan and create a prototype in the form of either a full scale version, 3D model (physical or virtual), draft or 'demo'.</p>	<p>Metro Minds STEAM Challenge Project guide and design folio for students – PROTOTYPE page</p> <p>https://www.sydneymetro.info/sites/default/files/document-library/Metro_minds_design_folio.pdf</p>	

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<p>TEST During this phase students will:</p> <p>- test the prototype on users</p> <p>- trial several iterations and make improvements</p> <p>- evaluate the solution against criteria for success</p>	<p><i>TE4-1DP evaluates innovative ideas and creative solutions to authentic problems or opportunities</i></p> <p> <i>contributes to groups and teams, suggesting improvements in methods used for group projects</i></p> <p> <i>persists with tasks when faced with challenges and adapts their approach where first attempts are not successful</i></p> <p> <i>evaluates whether they have accomplished what they set out to achieve</i></p>	<p><i>DT5-6 develops and evaluates creative, innovative and enterprising design ideas and solutions</i></p> <p> <i>independently and safely produces effective designed solutions for the intended purpose</i></p> <p> <i>evaluates their solutions using detailed criteria for success, including sustainability considerations</i></p>	<p>In this phase you will test the quality of your prototype by checking that:</p> <ul style="list-style-type: none"> - your product, service or environment is fit for its intended purpose - it meets the needs of the user <p>View this video produced by NN/g: <i>Usability Testing w. 5 Users: Design Process (video 1 of 3)</i> (3 mins) Discuss the meaning of the word 'iteration' and agree on a suitable definition. Discuss the benefits of doing several iterations and getting users to test each iteration.</p> <p>FIND A GROUP OF USERS, OR AN AUDIENCE, TO TEST YOUR PROTOTYPE ON</p> <p>Seek out some individuals or a small group who are willing to test your designed solution. Before proceeding with the test, gain approval from the teacher to engage with your nominated testers. Complete Q1 on the TEST page in your project guide.</p> <p>COLLECT AND CONSIDER FEEDBACK FROM THE USERS</p> <p>Observe the testers using your designed solution. Write down your observations of what they <i>did</i> and <i>said</i> while using it. After testing, interview the users and record or write down what they <i>thought</i> and <i>felt</i> about your product.</p> <p>PRODUCE SEVERAL ITERATIONS AND MAKE IMPROVEMENTS</p> <p>Reflect on the users' behaviours, interactions and feedback and make improvements to your 'product'. For each subsequent iteration, organise a different group of users to test your solution, while you repeat the 'DID, SAID, THOUGHT, FELT' observation process.</p> <p>ASSESS THE SUITABILITY OF THE SOLUTION TO ACHIEVE ITS INTENDED PURPOSE</p> <p>After you have finished all modifications and improvements to your designed solution evaluate it by answering Q4 of the TEST page in your project guide.</p>	<p>https://www.youtube.com/watch?v=RhgUirqki50</p> <p>Metro Minds STEAM Challenge Project guide and design folio for students – TEST page</p> <p>https://www.sydneymetro.info/sites/default/files/document-library/Metro_minds_design_folio.pdf</p>	

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<p>PITCH During this phase students will:</p> <p>- identify and communicate the benefits of their solution for an identified user or audience</p> <p>- produce a promotional video or presentation to 'sell' their solution to an identified audience</p>	<p>TE4-1DP <i>communicates innovative ideas and solutions for authentic problems</i></p> <p> <i>delivers presentations incorporating appropriate visual and multimodal elements</i></p>	<p>DT5-7 <i>uses appropriate techniques when communicating solutions to a range of audiences</i></p> <p> <i>produces rendered, illustrated views for marketing</i></p>	<p>HOW DO WE PREPARE A PITCH?</p> <p>View the video: <i>How to Give the Perfect Elevator Pitch</i> (by Bplans) (Stop video at 2 min 30 sec)</p> <p>In your group discuss, generate and play with ideas as you create a pitch for your product/solution based on the five-step sequence of PROBLEM > SOLUTION > MARKET > COMPETITION > TEAM.</p> <ol style="list-style-type: none"> 1. Describe and explain the <u>problem</u> that your product/solution addresses and why you thought this particular problem was worth fixing. 2. Present and demonstrate your <u>solution</u> in a spectacular way. 3. Clearly identify the <u>specific target market</u>, user group or audience that will use your product/solution. Explain how they will benefit from using or experiencing your solution. (How will they be better off?) 4. Name your competition. Briefly acknowledge one other design that has attempted to address a similar problem to yours and explain why your solution is superior. 5. 'Humanise' your pitch. <u>Introduce the members of your team</u> and have each member share one short interesting anecdote about a key moment in their design 'journey'. <p>Choose a delivery mode, or mix of modes, for your promotion. (You could even apply the whole design process over again to help you produce your pitch!)</p>	<p>https://youtu.be/8qwmH94BTiw?t=33</p>	

Teacher's evaluation of the effectiveness of this unit

To what extent did the students take 'ownership' of their work/project? (Who did the majority of the decision making: was it the students or their parents or the teacher?)

To what extent were students' learning goals observable/observed during the activities?

Identify which learning activities require modification to be more effective in the future.

Recommendations for future teaching/learning?

Notes

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Notes

A large, empty rectangular box with a thin black border, intended for taking notes.

