



YEAR 9 - STEM

The Georges River

PROJECT BASED LEARNING (PBL) PROGRAM

Mathematics Faculty

LIVERPOOL BOYS HIGH SCHOOL | FORBES STREET, LIVERPOOL, NSW



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STEM Project Planner: The Georges River

SECTION ONE:



Units/Curriculum: STEM	
Duration:	10 Weeks
Subjects covered:	Maths/HSIE/Literacy
Year Group:	9
Teachers/Staff:	Akkari/Touma/Singh
Driving Question(s):	
<p><i>Driving Question:</i></p> <p><i>How have the bridges constructed over the Georges River impacted the river communities and greater Sydney?</i></p>	
Associated Question(s):	
<ul style="list-style-type: none">- How long is the river? What suburbs does the river pass through?- What bridges cross the river?- What councils and government bodies are responsible for the river?- What recreational, military, residential, and industrial activities are undertaken on the river?- What are the physical properties of the Georges River?- How do people use the Georges River?- How has usage of the river impacted the river?	

Learning Intentions/Outcomes:

Students will:

- MA3-17MG locates and describes position on maps using a grid-reference system
- MA4-7NA operates with ratios and rates, and explores their graphical representation
- MA4-12MG calculates the perimeters of plane shapes and the circumference of circles
- MA4-13MG uses formulas to calculate the areas of quadrilaterals and circles, and converts between units of area
- MA4-16MG applies Pythagoras' Theorem to calculate side lengths in right-angled triangles, and solves related problems
- MA4-17MG classifies, describes and uses the properties of triangles and quadrilaterals, and determines congruent triangles to find unknown side lengths and angles
- MA4-18MG identifies and uses angle relationships, including those related to transversals on sets of parallel lines.
- MA4-19SP collects, represents and interprets single sets of data, using appropriate statistical displays
- MA5.1-1WMM uses appropriate terminology, diagrams and symbols in mathematical contexts
- MA5.1-2WMM selects and uses appropriate strategies in problem solving to solve problems
- MA5.1-6NA determines the midpoint, gradient, length of interval and graph linear relationships
- MA5-1-8MG calculates the areas of composite shapes, and the surface areas of rectangular and triangular prisms
- MA5.1-10MG applies trigonometry, given diagrams, to solve problems, including problems involving angles of elevation and depression
- MA5.1-11MG describe and applies the properties of similar figures and scale drawings
- MA5.2-2WMM interprets mathematical or real-life situations, systematically applying appropriate strategies to solve problems
- MA5.2-9NA uses the gradient-intercept form to interpret and graph linear relationships
- MA5.3-8NA uses formulas to find midpoint, gradient and distance on the Cartesian plane, and applies standard forms of the equation of a straight line
- EN5-1A responds to and composes increasingly sophisticated and sustained texts for understanding, interpretation, critical analysis, imaginative expression and pleasure
- EN5-4B effectively transfers knowledge, skills and understanding of language concepts into new and different contexts

Links to National Curriculum/STEM:

FOCUS ON READING

Literacy



In pairs, students use **visualising** and **questioning** techniques from FoR to create a text that describes succinctly their bridge. Peers will attempt to sketch from a reading of this text. Students will make **predictions** about the text and the structural integrity of the bridge. They will also be **making connections** with their research on bridges to their models.

Numeracy



Students will be explicitly learning numeracy to develop their scale replica of a bridge.

- Right-angled triangles and trigonometry
- Properties of geometrical figures
- Coordinate geometry
- Linear relationships

Information and communication technology capability



Students will be using computer programs and the internet to support them in designing their bridges.

Ethical and intercultural understanding





Students will learn about the importance of these bridges and why they are important to preserve.





Timeline:






Hook Event

Students watch video documentary on “The History of Georges River”.

Students visit to the Georges River

Step 1	Explicit teaching of the requirements for the portfolio (Element 1). Unpack the rubric and template for timeline and two-way table
Step 2	 Map activities Explicit teaching on finding location on maps using coordinates and map references, compass directions, and practice worksheets for students to develop skills on reading and interpreting maps.
Step 3	 Research the natural and man-made development of the Georges River. Build a timeline displaying information about the Georges River in chronological order. (Please refer to Appendix 2.3)

<p>Step 4</p>	 <p>Element 3: Collecting data and images of the bridges of the Georges river from internet searches and the visit to the Georges River.</p> <p>Critiquing the data collected and produce a two-way table displaying features of the bridges e.g. size, traffic, materials, engineering features (Please refer to Appendix 2.4)</p>
<p>Step 5</p>	 <p>Geometric constructions Angle relationships Angles on parallel lines</p> <p>Explicit teaching on Geometrical shapes (quadrilaterals), angles, triangle geometry, parallel and perpendicular lines.</p> <p>How these shapes may affect the structure of the bridge. Discuss the design process of building a bridge</p>
<p>Step 6</p>	 <p>Ratios and rates</p> <p>Explicit teaching on ratios, scale diagrams and scale factor.</p> <p>Importance to have a plan drawn to scale.</p>
<p>Step 7</p>	<p>Numeracy Assessment Task 1</p>
<p>Step 8</p>	<p>Critique of peer portfolio work using the portfolio checklist. (Please refer to Appendix 2.1)</p>
<p>Step 9</p>	<p>Research the bridges that are built on the Georges River. Choose one bridge and produce a top view, front view, and side view 2D drawing.</p>
<p>Step 10</p>	 <p>Personalised Research - In depth research on bridge of interest (Please refer to Appendix 2.5)</p> <p>Identify at least one bridge on the river that you would like to know more about and research the facts of the bridge.</p>

<p>Step 11</p>	 Create a text free PowerPoint/poster to illustrate the design features of their chosen bridge  FoR: Students will visualise their design and summarise their design in a PowerPoint/poster
<p>Step 12</p>	 Right angled triangles and properties <p>Explicit teaching on right angled triangles, Pythagoras' theorem, introduction to trigonometry, sine, cosine and tangent ratios, angles of elevation and depression</p>
<p>Step 13</p>	 Design and Build <p>Element 2: Building a replica of a Georges River Bridge using paddle pop sticks and/or other materials</p> <p>Draw a rough draft of the chosen bridge and in groups of 2 discuss materials needed to build a bridge.</p> <p>Draw a scaled isometric diagram of the chosen bridge.</p> <p>Build a scaled replica of bridge using paddle pop stick/matchsticks/other materials</p>
<p>Step 14</p>	<p>Share and Refining Replica (Element 2)</p> <ul style="list-style-type: none"> - Talk about replica - Gather feedback from peers and teachers (Please refer to Appendix 2.2) - Refine and modify bridge to the final product for the exhibition
<p>Step 15</p>	 FINAL PRESENTATION <p>Write a speech/PowerPoint presentation to accompany exhibition of bridge using timeline and two-way table to communicate their group's research and understanding (Refer to steps 3,4, 10 and 11)</p>
<p>Step 16</p>	<p>Second critique of peer portfolio work using the portfolio checklist. (Please refer to Appendix 2.1)</p>

<p>Step 17</p>	<p>EXHIBITION</p> <p>Students will exhibit and be assessed on the following 3 elements:</p> <ol style="list-style-type: none"> 1. Portfolio of work including photo diary 2. Scaled replica of bridge 3. Presentation at Exhibition
<p>Step 18</p>	<p>FINAL REFLECTION</p> <p>Students consolidate and summarise self and peer reflections on all aspects of the project and transfer to LBHS student report (Please refer to Appendix 1.1 and 1.2)</p>
<p>Step 19</p>	<p>Numeracy Assessment Task 2</p>
<p>Personalisation: <i>(How can students follow passions and allow variable depth in areas of interest?)</i></p>	
<ul style="list-style-type: none"> • Research which occupations are involved in the construction of bridge. (Element 1) • Present PowerPoint on the history and function of given bridge. (Element 2 and 3) • Make reference in their presentations to occupations involved in bridge construction that they may be interested in pursuing and give reasons why. This is included in element 3 of the exhibition 	<p>External Expertise: <i>(How will external expertise in this field be incorporated?)</i></p> <p>Guest speaker - Council ranger to visit school.</p> <p>Visit New Bridge Road Bridge and Weir, and attend talk by council ranger at this venue.</p>
<p>Hook or Immersion Event:</p>	
<ul style="list-style-type: none"> • Visit to the Georges River • Guest speaker • Video documentary 	<p>Possible Exemplars/Models:</p> <ul style="list-style-type: none"> • Teacher’s sample bridge – can be used as a scaffolding bridge • Student samples from previous years

Resources needed:		
On-site people, facilities:	Internet, library, council speaker	
Equipment:	Paddle pop sticks, Georges River map, glue	
Community resources:	Council and ranger. Elderly local residents with desire to share how Liverpool and Georges River has evolved.	
Assessment:		
Assessment Tools	Formative (F) / Summative (S)	Exhibition Element
Numeracy Tasks	F	Element 1
Literacy Tasks	F	Element 1 and 3
Portfolio Tasks	S	Element 1
Construction Tasks	S	Element 2
Success Criteria:		
<ul style="list-style-type: none"> • Element 1: Demonstrate competency in written exams and portfolio tasks • Element 2: Demonstrate competency in both the design brief of bridge and exhibition of the scale replica model of bridge • Element 3: Demonstrate competency in researching and summarising the history of the Georges River and the presentation of research findings at the exhibition in a chosen format e.g. PowerPoint, display board, annotated photos, mini-documentary/film 		
Critique Opportunities and Managing Multiple Drafts:	Critiquing Tools:	
<ul style="list-style-type: none"> • Portfolio sharing and critique session via checklist (Step 8 and 16). • Critique opportunity for bridge and refine via Bridge Critique Form (Step 14). 	<ul style="list-style-type: none"> • Portfolio checklist (Appendix 2.1) • Bridge critique form (Appendix 2.2) 	

Reflection Tools:	
Tools:	Template Provided:
Peer assessment (process)	Feedback Template (Appendix 1.1)
Peer assessment (product)	
Self-assessment (process)	Self-Reflection Template (Appendix 1.2)
Self-assessment (product)	
Teacher assessment (process)	Teacher's anecdotal records Marking Rubric } Project Student Report
Teacher assessment (product)	



All appendices referred to in this document can be found in the rear of this document and the associated Google Drive. The numeracy support resources are located in the associated Google Drive.



Portfolio Critique Checklist


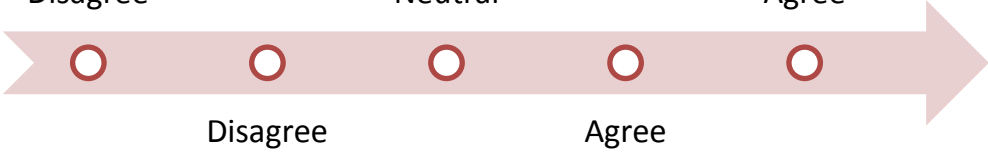

Circle the tick if your friend has completed the work or the cross if not and write a comment about their work.

✓/✗	Cover Page	✓/✗	Portfolio Critique 1
✓/✗	Contents Page	✓/✗	2D Drawings
✓/✗	Map Activities	✓/✗	In-depth Bridge Research
✓/✗	Georges River timeline of development	✓/✗	Presentation of Design Features
✓/✗	Collection and display of data about Georges River	✓/✗	Work sample on Right-Angled Triangles
✓/✗	Work sample on Geometric Constructions, Angles, and Parallel Lines	✓/✗	Design Brief of Bridge
✓/✗	Work sample on Ratios and Rates	✓/✗	Critique and Refinement of Bridge
✓/✗	Numeracy Task 1	✓/✗	Final Bridge Product
		✓/✗	Exhibition Presentation



Bridge Critique Form

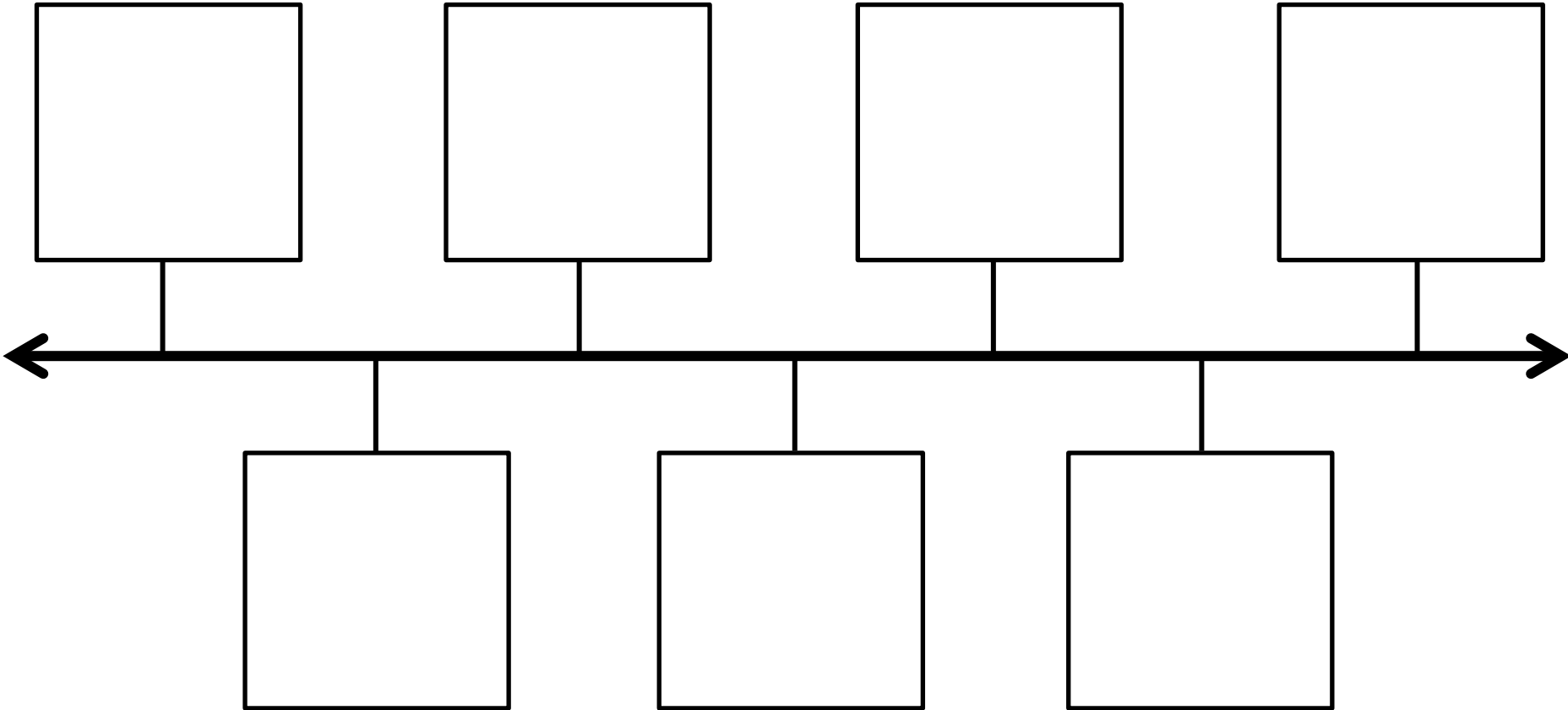
Complete the following critique form for your friend.

The bridge design is complete, organised and easy to follow	<p>Strongly Disagree Neutral Strongly Agree</p>  <p>Disagree Agree</p>
The bridge design brief explains one or more engineering features of the chosen bridge	<p>Strongly Disagree Neutral Strongly Agree</p>  <p>Disagree Agree</p>
The replica reflects the design brief and description of engineering features provided very effectively	<p>Strongly Disagree Neutral Strongly Agree</p>  <p>Disagree Agree</p>
Provide written warm feedback about the replica bridge	<hr/> <hr/> <hr/> <hr/>
Provide written cool feedback about the replica bridge	<hr/> <hr/> <hr/> <hr/>



Research Summary Timeline

Synthesise and summarise your research and display the data, with images, as a timeline in chronological order.





TWO-WAY TABLE

Using the data and images you have collected, complete the following two-way table about the features of each of these bridges below.

	Bridge Size	Type of Traffic	Materials Used	Engineering Features
Captain Cook's Bridge				
Voyager Point Bridge				
Alfords Point Bridge				
Tom Uglys Bridge				
Como Railway Bridge				

