Bellingen High School

Year 8 Integrated STEM program

Teacher: **Start Date:**

Class: **Completion date:**

SURVIVE THE SHAKE – STAGE 4 - STEM

Unit overview: **Earthquakes are the cause of many deaths in poor communities around the world. The geography, in areas where earthquakes are prevalent, means dwellings are often mud structures and bamboo is a common building material. Strong, yet simple dwellings need to be designed to maximise stability while minimising the loss of life.**

Design, produce and evaluate a multi-storey structure on a 14mm footprint that is able to withstand an Earthquake simulation

Duration: 20 weeks @ 4 periods a 2 week cycle [2 periods TAS, 1 period Science and 1 period Maths] **Assessment:** e-Portfolio and shake structure

REPORTING OUTCOMES

- Applies a broad range of contemporary materials, technologies and processes safely to design and construct built environments that meet social and environmental needs
- Applies management processes, evaluation techniques and communicates creative design ideas and solutions
- Identifies questions and problems that can be tested or researched and make predictions based on scientific knowledge
- Collaboratively and individually produces a plan to investigate questions and problems
- Communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols
- Applies appropriate mathematical relationships using reasoning

STEM - DIVERSITY OF LEARNING

Tick methods used for each topic [as many as required]

CLASS: _____ *[note: complete for EACH class]*

Cognitive Organisers

- ☐ Brainstorming
- ☐ Discussion
- ☐ Mind Map
- ❑ Visual Learning experiences
- ❑ Auditory Learning experiences
- ❑ Kinesthetic Learning activities
- ❑ Tactile Learning activities
- ❑ Visual Arts based activities
- ❑ Group Problem Solving
- ❑ Tests and Experiments
- ❑ Evaluation
- ❑ Oral Presentations
- ❑ Other _____

Special Needs / ESL Adjustments

- ☐ Variation of Presentation of Tasks
- ☐ Mentoring
- ❑ Environment modification
- ❑ Visual / Hearing Aids
- ❑ Re-formatting of work
- ❑ Photocopy enlargement
- ❑ Coloured paper
- ❑ Other _____

Students who need specific adjustments:

Gifted & Talented

- ☐ Extension Activities
- ❑ Adding Difficulty Degrees
- ❑ Other _____

Students who need extension:

Literacy & Numeracy

- ❑ Measuring
- ❑ Cloze Passages
- ❑ Completing Tables
- ❑ Glossary of Terms
- ❑ Arts based literacy
- ❑ 3D construction
- ❑ Costing
- ❑ Reading
- ❑ Other _____

ICT Components

- ❑ Spreadsheets
- ❑ Internet Research
- ❑ Use of Tablet
- ❑ Use of Apps
- ❑ PowerPoint
- ❑ Word Processing
- ❑ Information Transfer
- ❑ Emails
- ❑ Film Editing

General Capabilities: (See Teaching and Learning Program to identify links to General Capabilities)

Learning Across the curriculum used in this document are from the Board of Studies Teaching and Educational Standards (BOSTES) NSW
http://syllabus.bostes.nsw.edu.au/mathematics/mathematics-k10/learning-across-the-curriculum/

The cross-curriculum priorities:

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

The general capabilities:

- Critical and creative thinking
- Ethical understanding
- Information and communication technology capability
- Intercultural understanding
- Literacy
- Numeracy
- Personal and social capability

Other learning across the curriculum areas:

- Work and enterprise

The outcomes used in this document are from the Board of Studies Teaching and Educational Standards (BOSTES) NSW. http://www.boardofstudies.nsw.edu.au/syllabus_sc/

CROSS FACULTY OUTCOMES

TAS

4.1.1 applies design processes that respond to needs and opportunities **in each design project**

4.1.2 describes factors influencing design in the areas of study of Built Environments, Products, and Information and Communications

4.1.3 identifies the roles of designers and their contribution to the improvement of the quality of life

4.2.1 generates and communicates creative design ideas and solutions

4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources

4.3.1 applies a broad range of contemporary and appropriate tools, materials and techniques with competence in the development of design projects

4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques **in each design project**

4.4.1 explains the impact of innovation and emerging technologies on society and the environment

4.5.1 applies management processes to successfully complete design projects

4.5.2 produces quality solutions that respond to identified needs and opportunities **in each design project**

4.6.1 applies appropriate evaluation techniques throughout each design project

SCIENCE

SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge

SC4-13ES explains how advances in scientific understanding of processes that occur within and on the Earth, influence the

SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually

SC4-8WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems

SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations

SC4-11PW discusses how scientific understanding and technological developments have contributed to finding solutions to problems involving energy transfers and transformations

SC4-13ES explains how advances in scientific understanding of processes that occur within and on the Earth, influence the choices people make about resource use and management

MATHS

MA4-2WM: a student applies appropriate mathematical techniques to solve problems – problem solving

MA4-3WM: a student recognizes and explains mathematical relationships using reasoning – reasoning

MA4-12MG calculates the perimeters of plane shapes and the circumferences of circles

MA4-13MG uses formulas to calculate the areas of quadrilaterals and circles, and converts between units of area

MA4-4NA: compares orders and calculates with integers, applying a range of strategies to aid computation

MA4-5NA operates with fractions, decimals and percentage

MA4-6NA solves financial problems involving purchasing goods

MA4-7NA operates with ratios and rates, and explores their geographical representation

MA4-1WM: a student communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols – communicating

MA4-20SP analysis single sets of data using measures of location, and range

Engineering design process

http://cbsd.schoolwires.net/Page/32748

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge	• Identify previous knowledge • Design a tower and assess the stability of the tower	Students: ☐ Introduce STEM and this subject ☐ Watch some You tube clips on impacts of Earthquakes e.g. pool ☐ are introduced to the engineering design process and investigate the design model ☐ STEM challenge: Students design a spaghetti tower to support a marshmallow ☐ Introduce e-portfolio ☐ reflect on their tower design, asses its design and list any improvements they could make in their e-portfolio ☐ Hook: Students watch You tube clip/video from UTS/Mexican buildings ☐ Investigate though a classroom discussion 'What Earthquake engineering involves?' and how to engineer earthquake resistant buildings ☐ Activity: In groups identify 'what do you know about the impacts of earthquakes on society and environment' using the KWHL scaffold ☐ In groups identify 'What do you know about the impacts of earthquakes' using scaffold sheet	1	• Design model worksheet[Resource folder] • Japan's simulator video clip [Resource folder] • KWHL scaffold [Resource folder] • Basic scaffold [Resource folder] • Spaghetti • Marshmallows • Tape • Evaluation and Reflection sheet [Resource folder]
4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources	• Understand the design process	☐ STEM challenge: Students conduct a mini engineering challenge using the STLER wind kits. Students design and construct a tower to support a wind turbine using set materials and criteria. ☐ Student groups design and construct a tower to support a wind turbine with set number of blades ☐ Students map results of wind tower experiment in an excel table	2	• STELR wind kits • A4 paper • Straws • Sticky tape • stapler

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
SC4-13ES explains how advances in scientific understanding of processes that occur within and on the Earth, influence the choices people make about resource use and management	• Understand the design process	☐ Watch a video about an earthquake engineer from Haiti ☐ Answer understanding questions: 'How do you think you would feel if you were Pierre?' ' Why do you think earthquake engineering is important?' ☐ Read articles about the 2010 earthquake in Haiti. ☐ Discuss the Haiti earthquake and other earthquakes around the world ☐ Answer understanding questions: 'What types of buildings were destroyed in the earthquake?' 'As earthquake engineers, what can we do to minimize the chance of this happening again?' ☐ Activity: Build a shake table and explore how it simulates earthquakes. ☐ Reflect on their findings: 'What did you notice when you shook items on the shake table?' 'What difference did you see between a small magnitude earthquake and a large magnitude earthquake?' 'How do you think you will use the steps in the investigation process to engineer an earthquake-resistant building?' ☐ Identify and analyse the causes of earthquakes using the splash website ☐ Analyse Earthquake simulation from UTS virtual lab	1	• Ipads • http://tinyurl.com.p8se7qu • E-portfolio • http://splash.abc.net.au/home#!/media/31446/world-wonders-tv-show-earthquake • Haiti 2010 'How it works book or Earthquakes and Volcanoes' [p128-129][Resource folder] • Haiti article and pictures [Resource folder]
4.3.1 applies a broad range of contemporary and appropriate tools, materials and techniques with competence in the	• Assess design shapes • Problem solve	☐ Brainstorm 'What makes a building strong?' 'What are some parts of buildings you have heard of?' 'Which parts do you think help a building stay strong during an earthquake? Why do you think so? ☐ Discuss and view various building skeletons 'What do you see inside the two buildings'	2	• Paper • Bendy straws • Tape • Glue • Scissors

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
development of design projects **MA4-2WM**: a student applies appropriate mathematical techniques to solve problems – problem solving **MA4-3WM**: a student recognizes and explains mathematical relationships using reasoning – reasoning **MA4-12MG** calculates the perimeters of plane shapes and the circumferences of circles **MA4-13MG** uses formulas to calculate the areas of quadrilaterals and circles, and converts between units of area		☐ Activity: build various 3D paper shapes, 3D Gumdrop domes and 2D straw shapes ☐ Evaluate the various shapes to determine the shapes with the best structural integrity. ☐ STEM challenge: make a building unit that can be stacked up together in order to make a complete building skeleton to test on the shake table ☐ Make model buildings and use the shake table to determine the shape and size buildings to best withstand earthquakes ☐ Analyse results to add to their e-portfolio 'What shapes and sizes did you try that best survived the earthquakes? Why do you think so?		• Gumdrop dome worksheets [Resource folder]
	• Problem solving	☐ Discuss why the buildings slid off the shake table during the last task ☐ Design a way to stop the buildings sliding off the table using items provided (piece of string, a toothpick, a paperclip, and a	1	

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
		brass fastener ☐ Analyse the information gathered today and enter information into their e-portfolio 'What stopped your building from sliding? Why did it work well?' 'How do you think you could use these ideas to stop real buildings from sliding during an earthquake?		
4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources	• Assess the structural integrity of materials and joins	☐ STEM challenge: construct the tallest tower from straws and paper to support a tennis ball under windy conditions ☐ Analyse the information from your trials ' What design alterations could be made to make your structure withstand higher wind gusts	2	• Tennis balls • Straws • Paper • Sticky tape • fan
4.5.1 applies management processes to successfully complete design projects **SC4-13ES** explains how advances in scientific understanding of processes that occur within and on the Earth, influence the choices people make about resource use and management		☐ watch You tube clip on earthquake waves affecting a swimming pool ☐ Discuss the concept of shearing ☐ Discuss the outcome of shear during a 7.0 magnitude earthquake on a building ☐ Design a way to stop the buildings shearing during an earthquake using items provided (piece of string, a coffee stirrer, a pipe cleaner, a straw, and a brass fastener) 'How do you think you could use these materials to make sure your building unit does not shear during an earthquake?' ☐ Test anti-shearing design on the shake table ☐ Analyse the information from these designs and add to the e-portfolio 'What ideas did you try that stopped your building from shearing?'	1	• Swimming pool earthquake clip [Google Drive]

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
		'Why do you think those designs worked well?' 'How could you use these ideas to engineer real buildings that will not shear during an earthquake?' ☐ Portfolio lesson		
4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources **SC4-8WS** selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems **SC4-6WS** follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually		☐ STEM challenge: to design, construct and evaluate a mini marshmallow tower. ☐ Analyse the stability of the mini-marshmallow tower on the shake table ☐ Analyse information about the structural supports used in buildings around the world e.g. tower in Japan ☐ Add to e-portfolio	**2**	• Mini Marshmallow worksheets [Resource folder]
SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types	• Analyse information	☐ Watch You tube clip of top10 earthquakes in recorded history https://www.youtube.com/watch?v=45NB35w3Jw8 ☐ Analyse different earthquakes from around the world ☐ Discuss photos of the destruction of earthquakes on several buildings and landscapes	**1**	• You tube clip • https://www.youtube.com/watch?v=45NB35w3Jw8

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
and representations		☐ Add to Portfolio		
4.1.2 describes factors influencing design in the areas of study of Built Environments, Products, and Information and Communications **SC4-11PW** discusses how scientific understanding and technological developments have contributed to finding solutions to problems involving energy transfers and transformations	• Understand the design process	☐ Use the information gathered in previous lessons to design an earthquake-resistant building that can withstand a 7.0 magnitude earthquake from the shake table 'What can you tell me about your design?' ☐ Test their buildings ☐ Evaluate designs 'What did you do to make your model building earthquake-resistant? 'Do you think your design is working well? How do you know? 'What would you improve next time?' ☐ Make any improvements to their design before final testing 'What are you improving? How do you think this will make your model building more earthquake resistant? ☐ Each group to set up their shake table and model building ☐ Groups take turns sharing information about their buildings and demonstrate how well it survives a 7.0 magnitude earthquake ☐ Combine all the shake tables together to make a city that can be tested in a 7.0 magnitude earthquake. Have volunteers shake the tables at the same time and watch the result ☐ Analyse the results 'Were you surprised by what happened when your building experienced an earthquake? Why or why not? 'What would you improve about your building if you had more time?'	2	
4.1.3 identifies the roles of designers and	• Link investigations to	☐ Watch quake safe video ☐ Discuss the design process again in relation to building a large	1	• Quake safe (New Inventors)

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
their contribution to the improvement of the quality of life **SC4-13ES** explains how advances in scientific understanding of processes that occur within and on the Earth, influence the choices people make about resource use and management	real world situations	earthquake resistant building ☐ Re – affirm the design process in relation to the shake prove building ☐ Discuss the concept of design sketching providing examples		
4.2.1 generates and communicates creative design ideas and solutions	• Design of major project	☐ Preliminary design sketch of design using large butcher paper ☐ Use tablets to take photos of their concept sketches to place in their e-portfolio ☐ Students determine the criteria for success of the project ☐ Students are guided through the criteria for success of the project ☐ Add information to e-portfolio	2	• Butchers paper • Tablets
4.5.1 applies management processes to successfully complete design projects **MA4-4NA**: compares orders and calculates with integers, applying a range of strategies to		☐ Cost of materials and budget analysis of their project using scaffold sheet ☐ Transfer information to an excel spreadsheet for analysis ☐ Assess environmental rating of building material ☐ Cost of materials and budget analysis using modifies scaffold sheet	1	• Budget scaffold sheet • Tablets • Modified scaffold sheet

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
aid computation **MA4-5NA** operates with fractions, decimals and percentage **MA4-6NA** solves financial problems involving purchasing goods **MA4-7NA** operates with ratios and rates, and explores their geographical representation				
4.1.2 describes factors influencing design in the areas of study of Built Environments, Products, and Information and Communications		☐ Describe and evaluate the social and environmental impacts of Earthquakes and how this relates to economic and resource availability of building materials. Refer to earthquake pictures used in previous lessons ☐ Describe the social and environmental impacts using guided questions and scaffold	1	• Laminated earthquake posters
4.4.1 explains the impact of innovation and emerging technologies on society and the environment		☐ Explore height of structures to amount of destruction during an earthquake. ☐ Watch video ☐ Solve Jenga earthquake puzzle ☐	1	
4.1.1 applies design processes that respond to needs and		☐ Build model prototype ☐ Watch kids and architecture video	4	

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
opportunities **in each design project** **4.3.2** demonstrates responsible and safe use of a range of tools, materials and techniques **in each design project** **4.5.2** produces quality solutions that respond to identified needs and opportunities **in each design project**				
		☐ Compile Portfolio	1	
4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources **4.5.1** applies management processes to successfully complete design projects		☐ Complete tower destruction	2	
MA4-1WM: a student communicates and connects mathematical ideas using appropriate terminology, diagrams		☐ Compile data collection from tower destruction ☐ Analyse and evaluate tower effectiveness against earthquakes ☐ Complete e-portfolio for presentation	2	• Spread sheets • Word processing • Photo editing

Outcomes	Students learn to:	Evidence of Learning	Number of Lessons	Resources
and symbols – communicating **MA4-20SP** analysis single sets of data using measures of location, and range				
		☐ Portfolio production cont.	1	
4.6.1 applies appropriate evaluation techniques throughout each design project		☐ Evaluation and folio presentation	2	

Key to Lessons: MATHEMATICS TAS SCIENCE ANY ☐ Modified outcome ☐ Extension outcome