 STEM Fair — Stage 3

Term 1, 2, 3 and 4

Stage 3 are given the opportunity to engage collaboratively in planning an authentic, sustained investigation that will be showcased through an exhibition for the school community and judged by secondary feeder school students with awards handed out. Students from K-6 are invited to engage with students in stage 3 and ask questions about their projects. Students need to hand in a proposal containing an overarching question, hypothesis, procedure and outline of what their project entails. Students are then asked to start planning their sustained investigation as well as an oral explanation and justification of their choice. Students need to demonstrate known STEM principles or original research using fair testing and/or design principles.

Through our STEM fair, we plan to engage our school community by promoting innovative learning and interest in STEM through exemplars, discussions and a shift in pedagogy to improve classroom practice and maximise student outcomes. This initiative has been further supported in term 4 by the introduction of a STEM transition program. Specialist staff and students from Hastings Secondary College work with Year 5 on STEM learning activities, which support a shift in methodology towards future focused pedagogy and authentic project based learning.

Purpose/context

Previously the exhibition was called the Science Fair and consisted of science experiments; this was an isolated home-based project. Students walked around to look at projects but there were no real discussions or authenticity to the experiments. This year, the professional learning we have had, has engaged staff and has created a pedagogical shift. Through our guidance and leadership of STEM, staff are aware of the need to align themselves with future focused pedagogies that facilitate explicit teaching of skills at point of need and professional communication and collaboration through discussions, planning and investigations. This has resulted in a STEM based pedagogy that is demonstrated within classrooms to facilitate 21st Century fluencies and maximise learning outcomes for all students. Students will be equipped with the skills, knowledge and experience to problem solve, collaborate, communicate and use creative, critical and innovative thinking.

Big ideas

Sustained Investigation

Exploration

Innovation

Mathematical understanding and application

Design

Driving question

How do students gain and apply knowledge, deepen their understanding and develop creative and critical thinking skills within an authentic context (STEM Fair)?

Assessment overview

Write an overview of what assessments students will complete as part of their assessment of, as and for learning.

1. Assessment for Learning – students completed a STEM Fair proposal and staff provided timely feedback about their learning and how to improve through conferencing (Appendix 1)
2. Assessment as Learning – monitoring own progress through the use of a checklist (Appendix 2)
3. Assessment of Learning – assessment Criteria and Feedback (Appendix 3)

Syllabus references

Outcomes and syllabus content referenced in this document are from:

* [Science (incorporating Science and Technology K-6) K-10 Syllabus](http://syllabus.nesa.nsw.edu.au/science/science-k10/) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2012
* [Mathematics K-10 Syllabus](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2012

| Syllabus outcomes/content | Teaching, learning and assessment | Resources |
| --- | --- | --- |
| ST3-5WT plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identified constraints | AssemblyStage 3 Assembly showing and discussing a slide show of past exemplars of experiments in previous Science Fairs and question time was provided for clarificationLiteracy Continuum* Vocabulary knowledge – cluster 12, 13, 14
* Aspects of speaking – cluster 11, 12

Quality Teaching – Significance * Background Knowledge, level 4
* Knowledge Integration, level 4
* Connectedness, level 4

Outline of processes and information regarding STEM | PowerPoint (Appendix 4) |
| ST3-4WS investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence- based conclusions and develop explanations ST3-5WT plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identified constraintsMA3-1WM describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventionsMA3-2WM selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigationsMA3-3WM gives a valid reason for supporting one possible solution over anotherMA3-18SP uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables | ClassroomDiscussion and brainstorming about the importance of STEM education in the 21st Century.Collaboration of ideas in groups regarding conducting appropriate investigation methods, including fair tests, to answer questions or solve problems.In small groups, using own prior knowledge to predict and construct a hypothesis to investigate challenge.Safety – using equipment and materials.Construct and use a range of representations, including tables, graphs and labelling of diagrams.Explicit teaching in using numerical techniques to analyse data and draw conclusions from information, including calculating the means and percentages of data sets.Explicit teaching in the use of thinking strategies such as creativity in mind mapping, brainstorming, sketching and modelling.Discussions in small groups in sharing techniques for documenting design ideas for the STEM Fair.Time given to students to research and build an investigation that is based on Science, Technology, Engineering and Mathematics.Students write a proposal that included their hypothesis, question for investigation and procedure.Literacy Continuum* Vocabulary knowledge – cluster 12, 13, 14
* Aspects of speaking – cluster 11, 12
* Reading texts – cluster 11, 12, 13, Comprehension: cluster 11, 12, 13, 14
* Aspects of writing – cluster 12, 13
* Aspects of speaking – cluster 11, 12, 13, 14

Quality Teaching* Significance
	+ Background Knowledge, level 4
	+ Knowledge Integration, level 4
	+ Connectedness, level 4
* Intellectual Quality
	+ Deep Knowledge – level 4
	+ Deep Understanding – level 4
	+ Metalanguage – levels 4 and 5
* Quality Learning Environment
	+ Explicit Quality Criteria – level 5
	+ High Expectations level 4
	+ Student Self-Regulation – level 4
	+ Student Direction: level 4
 |  |
| ST3-4WS investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence- based conclusions and develop explanations ST3-5WT plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identified constraintsNB Knowledge and Understanding outcomes are dependent on child’s chosen project. | Autonomous LearningStudents spend time collaborating and communicating ideas that work towards creating a sustainable, authentic investigation.Fair testing of investigation over a designated time frame.Interpretation of results to create a finding and draw conclusions from results.Creating visuals/oral presentation to support their investigation | <http://www.scootle.edu.au/ec/viewing/R11092/index.html>  |

Culminating event, activity, or product

Showcase

In term 3 during Education Week, students were asked to set up a space in their classrooms to showcase their investigation and discuss findings with visiting students from K-6, student judges from Hastings Secondary College (HSC) and community members. This culminating task allowed students to use the processes of Working Scientifically and Working Technologically with greater independence. Students were self- reliant in undertaking a range of scientific investigations and design projects, and in collaboratively completing the tasks.

Evaluation

* Were all students engaged in the STEM Fair process?
	+ Teacher reflection – all students in stage 3 participated in the STEM Fair. All students were deeply involved all of the time and this was evident by their level of engagement, interest and comprehensive explanations that demonstrated their understanding of the task.
* Did the projects reflect STEM principles and set criteria?
	+ Teacher Reflection – the majority of projects met the set criteria and provided students with an opportunity to independently use their STEM knowledge, understanding and skills to research and conduct an investigation which was of particular interest to them. The projects fell into two broad categories:
	1. Demonstration of known STEM principles eg. How sound travels, or demonstrating gravity.
	2. Original research (using fair testing/controlled experiment procedures) to discover new information or to solve problems eg. How safe is lunchbox food under a variety of packaging and temperature conditions?
* How did students present deep understanding of their task?
	+ Teacher reflection – students demonstrated their deep understanding of their chosen project through their ability to follow instructions, pose the questions for investigation, predict the likely outcomes and collect, record and analyse the data and information. Students were able to construct tables and graphs to organise data and identify patterns. They also used evidence to draw conclusions and develop an explanation and communicate the process and findings.
* Did the projects reflect a diverse range of scientific, technological, engineering and mathematical principles?
	+ Teacher reflection – the projects reflected sound STEM principles. There was a lack of coding, circuitry and robotics knowledge and experience, this could be due to the fact that traditionally our showcase was run as a Science Fair and we also identified that a lack of resources within the classroom inhibited teachers in their delivery of STEM activities.
* How did involving students from Hastings Secondary College (HSC) in the assessment process contribute to building relationships and sharing an understanding of STEM principles with our local high schools?
	+ Teacher reflection – the involvement of secondary students had a positive impact on stage 3 students. They were able to relate to each other and felt comfortable in sharing ideas and explanations about their projects with the students. The secondary students were pivotal in our transition process as they enthused the students by explaining STEM activities (STEM Academy) for their HSC.

Future Action

To build knowledge and understanding in STEM principles we are resourcing classrooms with Edison robots and BBC MicroBits and to build capacity in staff, we are conducting professional learning in the use of Edison Robots and the use of BBC MicroBits. We also see this as an opportunity to use specialist staff and students from Hastings Secondary College to engage and build enthusiasm with our Year 5 students and couple this within our transition program.

Written By Cherry Nelson and Sally Norman 2016

Student information

The time has come for you to start preparing for this year’s STEM Fair! The proposed date is Thursday 4th August, to coincide with Education Week.

Here is a checklist of things you will need to do to ensure you have a successful STEM Project:

* Decide if you are going to complete your project independently or in a small group (no more than 4 students).
* Decide on a suitable project. Remember, your projects are displayed in classrooms with not much space between groups. Groups are given 1 table to present their project and individuals half a table.
* Complete STEM Fair Project Proposal and return to your class teacher. Due no later than Monday 27th June, 2016.
* Use the STEM Fair checklist to help you organise your STEM Project and keep you on track.

What Makes a Suitable Project?

The object of the STEM Fair is to provide you with an opportunity to independently use your science, technology and mathematics skills to research/investigate a phenomenon that is of particular interest to you. Past student studies have fallen into two broad categories:

* Demonstration of known scientific principles/phenomena eg. How sound travels, or demonstrating gravity.
* Original research (using fair testing/controlled experiment procedures) to discover new information or to solve problems eg. How safe is lunchbox food under a variety of packaging and temperature conditions?

If you are not sure that your project is suitable, please talk to your teacher or see me before handing in your proposal.

Below are some guidelines on suitable projects and a few websites to give you various project ideas. Please, no projects that erupt, explode or are potentially dangerous! Volcanoes, silly putty, sludge or slime and items of a dangerous nature such as gas or naked flames are not permitted for Work, Health and Safety (WHS) reasons.

Websites

Science Club website – an overview of the science involved in marketing –<http://scienceclub.org/scifair.html>

Science Project website – sample topics for making models and conducting demonstrations – <http://www.scienceproject.com/projects/index/elementary.asp>

Science Buddies website – science resources for home and school – <http://sciencebuddies.org>.The Science Buddies website also has some great information in the ‘Science Fair Project Guide’, on how to go about your scientific research.

Assessment detail

Each project will be assessed against the following assessment criteria:

| Part | Criteria | Points |
| --- | --- | --- |
| 1. | The project has engaged students in the processes of:* investigating
* designing & making
* using technology
 | 25 Points |
| 2. | The project contributes to student understanding/knowledge and in Science and Technology | 25 Points |
| 3. | The project display is neatly presented, is clearly labelled with explanatory information and is engaging to the observer | 25 Points |
| 4. | Students can effectively discuss project principles, methodology and outcomes | 25 Points |

Projects will be assessed on the day by senior students from Hastings Secondary College.

Fair testing/controlled experiment procedure

In order to make valid comparisons, variables have to be identified and fixed, apart from the variable of interest. The example below is provided to enhance understanding of testing procedure. This may not be copied for your own project.

Example

Question – are lunch box sandwiches at or below recommended storage temperatures?

1. Establish a temperature benchmark by researching Dept. Health guidelines eg. 10°C
2. Identify variables
	* type of lunchbox (insulated/non insulated)
	* ice brick/no ice brick
	* location of lunch box
3. Identify variable of interest ie location. Identify differing locations eg 1 in the sun, 2 in the shade but outdoors, 3 in the shade but indoors
4. Fix other variables
	* same types of lunch boxes for each location
	* no ice brick in any lunch box
5. Test temperature variations within lunch boxes over a set period eg. 9am, 10am, 11am, 12pm
6. Use data collected to make statements eg the coolest lunch box was indoors but its temperature was above Dept. Health guidelines.

Other sets of data can be obtained by altering a variable eg put ice bricks (same type & size) in each lunch box and testing temperatures using the procedures above.

In this fashion different sets of data can be obtained from which valid statements may be made. Eg sandwiches can only be kept at or below a safe level of 10 degrees Celsius if you use an insulated lunch box with an ice brick and it is kept indoors, in the shade.

| Variable | non-insulated lunch box | insulated lunch box | non-insulated lunch box with an ice brick | insulated lunch box with an ice brick |
| --- | --- | --- | --- | --- |
| Outdoors in the sun | 28oC | 23oC | 19oC | 15oC |
| Outdoors in shade | 25oC | 21oC | 16oC | 18oC |
| Inside in the shade | 20oC | 18oC | 14oC | 10oC |

Mrs Watson

STEM Fair coordinator

** STEM fair project proposal

Please return this completed proposal to your teacher by

Name

Topic

Question

Hypothesis

Procedure

Materials

Directions

STEM fair project – checklist

Use this checklist to help you organise your STEM fair project. Tick off when you have completed each step.

[ ]  Choose a topic that interests you

[ ]  Write a question that you can investigate

[ ]  Research your topic

[ ]  Write a hypothesis

[ ]  Write a step-by-step procedure to test your hypothesis

[ ]  Make a list of materials that you will need

[ ]  Carefully conduct your experiment. Keep careful written records of your results

[ ]  Draw a conclusion and organise your results in an easy to read chart or graph

[ ]  Construct a display for the science fair. You can include charts, graphs, illustrations, photos, information, models and/or demonstrations of your experiment

[ ]  Prepare an oral explanation. You will need to be prepared on the day to be able to explain your project to others

STEM fair marking sheet

Group members

Project title

| Part | Criteria | Points | Mark out of 25 |
| --- | --- | --- | --- |
| 1. | The project has engaged students in the processes of:* investigating
* designing & making
* using technology

For example* Background Research is diverse, multiple sources, complete citations
* How creative is the student's project idea?
 | 25 Points |       |
| 2. | The project contributes to student understanding/knowledge and in Science and TechnologyFor example* Is the question clear?
* Can hypothesis be tested?
* Gives specific, step-by step directions

States whether the hypothesis was supported or not. Gives data and results as support. | 25 Points |       |
| 3. | The project display is neatly presented, is clearly labelled with explanatory information and is engaging to the audienceFor example – presentation* Neatness/Professional
* Clarity of Text

Use of images, graphics, tables, and graphs and/or images | 25 Points |       |
| 4. | Students can effectively discuss project principles, methodology and outcomesFor exampleStudent spoke clearly to judges and were confident in explaining their project | 25 Points |       |

Total marks out of 100