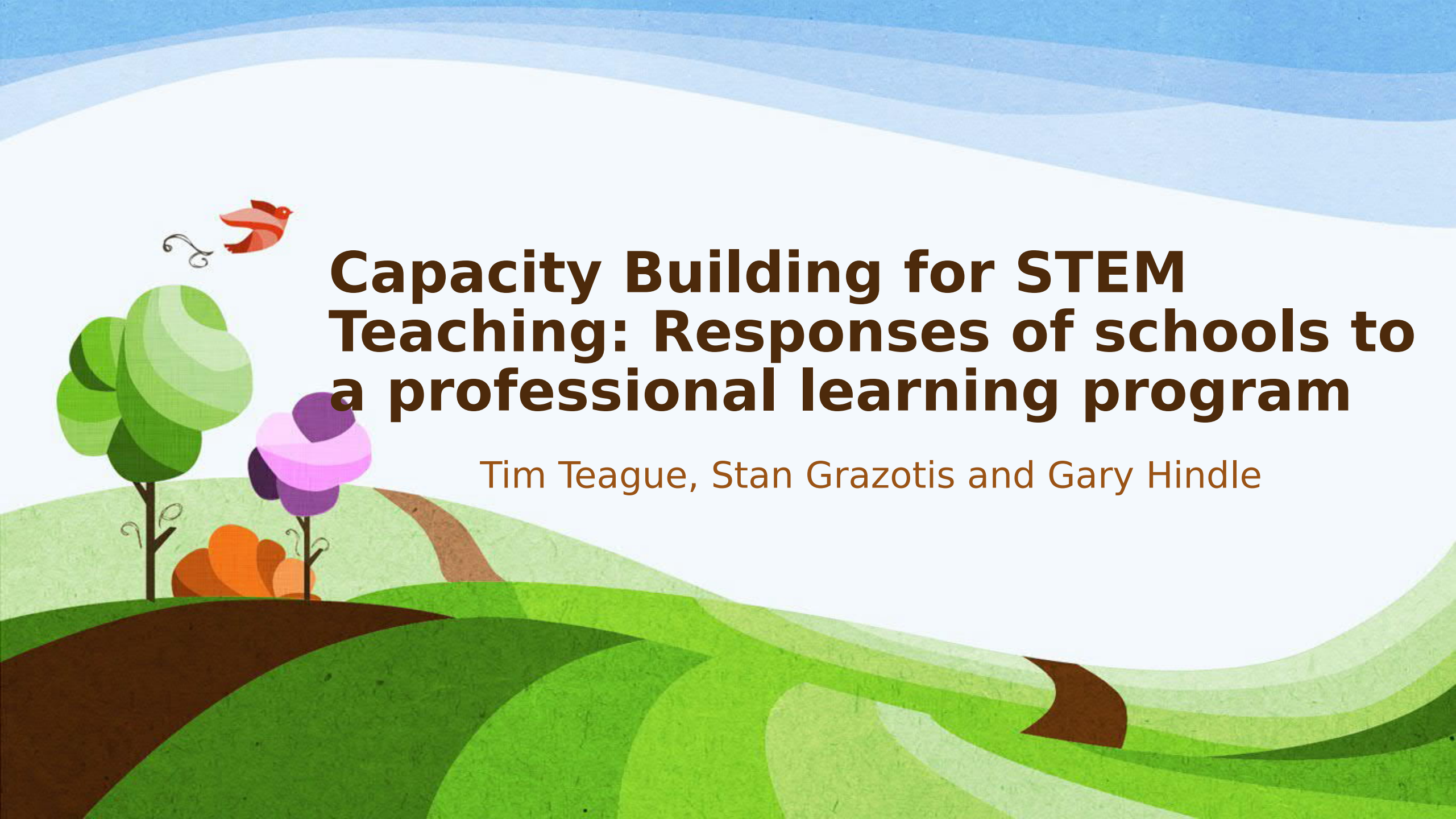


Capacity Building for STEM Teaching: Responses of schools to a professional learning program

Tim Teague, Stan Grazotis and Gary Hindle

Today

- Hello!
- Today’s Presentation
  - National Education Context
  - State Education Context
  - Local Education Context (Geelong Region & Local Primary Schools)
  - National Science Agenda
  - SEPS Program
  - STEM at Bell Park North
  - STEM at Rollins P.S

“Kids are smart – trust them – don’t talk so much, get out of their way and allow them to show you what they already bring to the table”

- Rob Vingerhoets

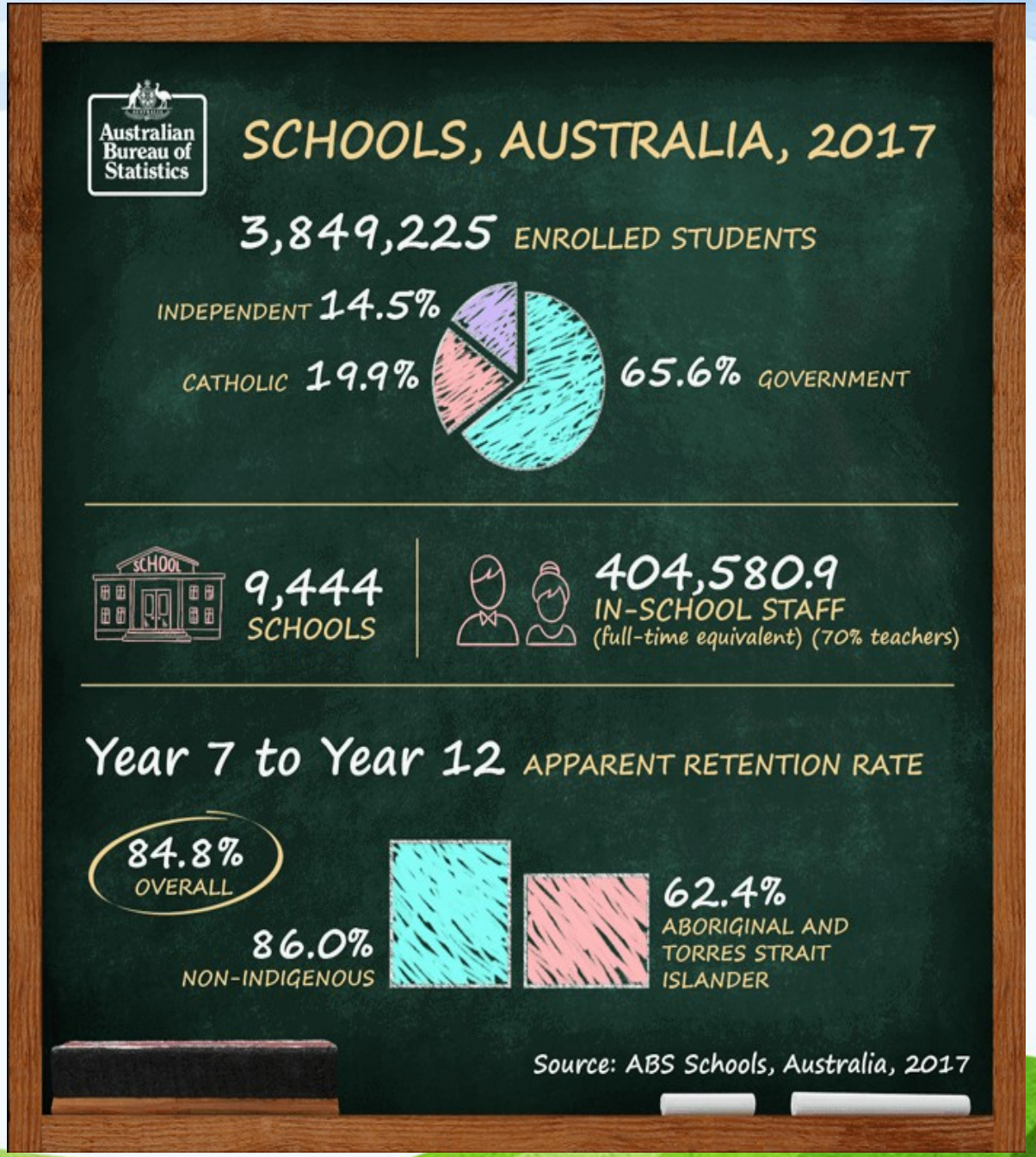
Australian Education in Context

- Starting age for students is usually around the age of 5, sometimes 4 years old.
- Typical Primary School day - Literacy, Numeracy and Inquiry.
- Our curriculum is a continuum from Foundation – Level 10
- Science is certainly **NOT** a prominent feature of our daily practice or assessment schedule.
- NAPLAN - Held annually for years 3, 5, 7 and 9. This determines Commonwealth funding.

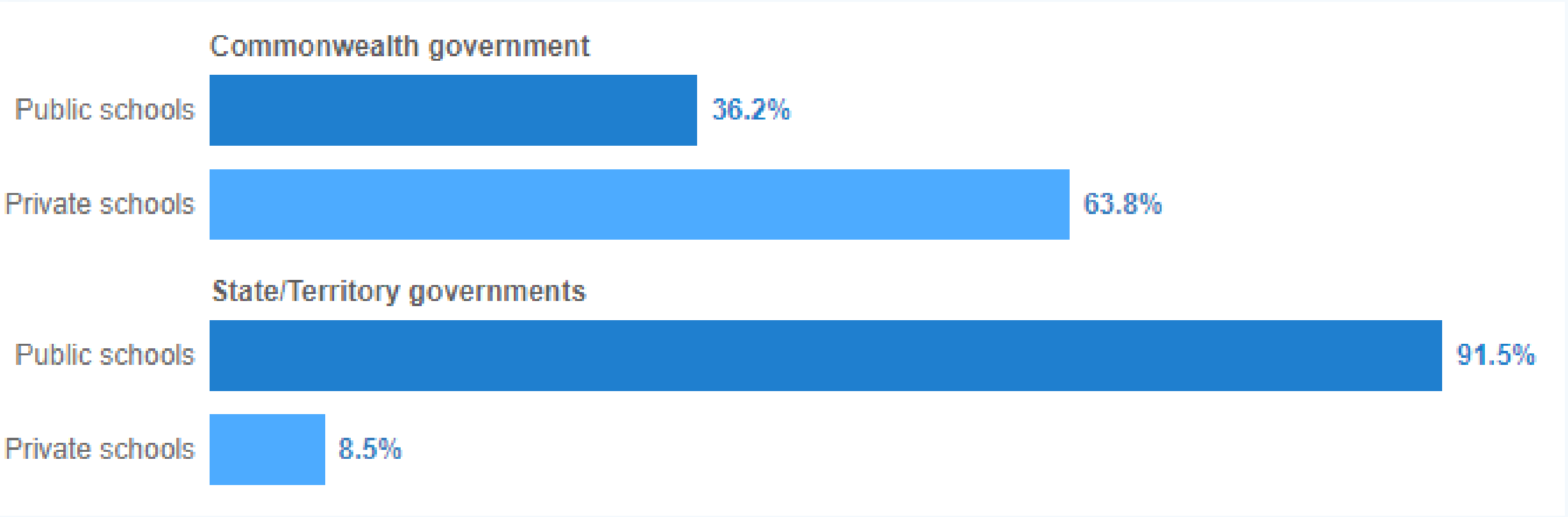
Australian Education in Context

We have 3 education systems:

- Government
- Independent
- Religious



Australian Education Funding in Context



Australian Education in Context (State)

Framework for Improving Student Outcomes (FISO).

Australian Education in Context (State)

Learning Areas

- The Arts
  - Dance
  - Drama
  - Media Arts
  - Music
  - Visual Communication Design (7-10)
  - Visual Arts
- English
- Humanities
  - Civics and Citizenship
  - Economics and Business
  - Geography
  - History
- Languages
- Health and Physical Education
- Mathematics
- Science
- Technologies
  - Design and Technologies
  - Digital Technologies

Victorian Curriculum F–10		*Students with Disabilities (Levels A to D)*				Foundation	Levels 1 – 2		Levels 3 – 4		Levels 5 – 6		Levels 7 – 8	
		A	B	C	D									
English		Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standa
Mathematics		Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standa
The Arts	Dance	Standard	Standard	Standard	Standard	Standard	→	Standard	→	Standard	→	Standard	→	Standa
	Drama	Standard	Standard	Standard	Standard	Standard	→	Standard	→	Standard	→	Standard	→	Standa
	Media Arts	Standard	Standard	Standard	Standard	Standard	→	Standard	→	Standard	→	Standard	→	Standa
	Music	Standard	Standard	Standard	Standard	Standard	→	Standard	→	Standard	→	Standard	→	Standa
	Visual Arts	Standard	Standard	Standard	Standard	Standard	→	Standard	→	Standard	→	Standard	→	Standa
	Visual Communication Design												→	Standa
Critical and Creative Thinking		Standard	Standard	Standard	Standard	→	→	Standard	→	Standard	→	Standard	→	Standa
Ethical Capability						→	→	Standard	→	Standard	→	Standard	→	Standa
Health and Physical Education		Standard	Standard	Standard	Standard	Standard	→	Standard	→	Standard	→	Standard	→	Standa
The Humanities	Civics and Citizenship								→	Standard	→	Standard	→	Standa
	Economics and Business										→	Standard	→	Standa
	Geography	Standard	Standard	Standard	Standard	→	→	Standard	→	Standard	→	Standard	→	Standa
	History	Standard	Standard	Standard	Standard	→	→	Standard	→	Standard	→	Standard	→	Standa
Intercultural Capability						→	→	Standard	→	Standard	→	Standard	→	Standa
Languages	F–10 Sequence					→	→	Standard	→	Standard	→	Standard	→	Standa
	7–10 Sequence												→	Standa
Personal and Social Capability		Standard	Standard	Standard	Standard	Standard	→	Standard	→	Standard	→	Standard	→	Standa
Science		Standard	Standard	Standard	Standard	→	→	Standard	→	Standard	→	Standard	→	Standa
Technologies	Design and Technologies	Standard	Standard	Standard	Standard	→	→	Standard	→	Standard	→	Standard	→	Standa
	Digital Technologies	Standard	Standard	Standard	Standard	→	→	Standard	→	Standard	→	Standard	→	Standa

The Victorian Curriculum

Australian Education in Context (State)

- *Department of Education and Training are encouraging schools to adopt STEM culture, to meet future industry demands.*
- *There is no guiding framework for this.*

How do you develop a culture without a set of agreed standards?

Australian Education in Context – Geelong

- 50 Primary schools
- 10 secondary schools
- The Geelong Tech School
- Deakin University – 2 campuses.
- BioLAB
- Gordon TAFE

Australian Education in Context (Local)

- Low socio-economic area.
- Students come from backgrounds that include:
  - Single parent families
  - Trauma and abusive environments
  - Drug affected homes
  - English as a second language
  - Refugee families
  - Learning disabilities and difficulties
- Many teachers enrol their children in private schools.

Where we come from…Bell Park North Primary School

STEM within the National Innovation and Science Agenda (Theory)

- There are 5 main areas of focus for STEM in Australia:
  - Increasing student STEM ability, engagement, participation and aspiration.
  - Increasing teacher capacity and STEM teaching quality
  - Supporting STEM education opportunities within school systems.
  - Facilitating effective partnerships with tertiary education providers, business and industry.
  - Building a strong evidence base.

- Problem: Many of the initiatives aimed at students begin at secondary level.

STEM within the National Innovation and Science Agenda (In Practice)

- 20-year decline in year 12 science and maths participation
- Research has found engaging children in science before the age of 11 was critical to their long-term interest in the subject.
- One of the recommendations…was for all primary schools to have a specialist science/STEM teacher.
- If the teacher is engaging, wanting to work **WITH** the student, then the student wanted to study it the next year.

STEM within the National Innovation and Science Agenda (Geelong)

- We are currently following global trends but have an eye on becoming an innovator.
- Geelong ☾ ‘hard’ industry such as aluminium smelters (ALCOA) and the car industry (FORD) have closed.
- There were concerns for unemployment rates ☾ but new tech jobs now employ more people than the previously mentioned industries
- Deakin University’s Carbon Revolution.
- Repurposing: Wind turbines are now also produced in the old Ford factory.

STEM within the National Innovation and Science Agenda - Industry

From this...

To this...

SEPS - STEM and Entrepreneurship in Primary Schools

- SEPS - STEM and Entrepreneurship in Primary Schools is a recent collective of Geelong schools under the direction of Deakin University.

- It is a learning program aimed at upskilling primary schools and allowing 13 schools to support one another whilst fostering a love of STEM.

- Some schools have be ‘doing’ STEM for 6-7 years whilst others have only just begun their journey.

SEPS - Teacher Capacity Building

- Collaboration.
- Curriculum Development and Implementation
- Student Learning and Engagement
- GALS (Girls as Leaders in STEM)
- Great to see different systems – pick up points that work for our school context.
- There has been a lack of STEM leadership/development with schools but Deakin has provided this opportunity to participate in this learning program.

STEM @ BPNPS (Overarching Framework)

- STEM did not exist in 2017. Through SEPS, we have collaborated to establish the following commitments to STEM:

  - Two STEM Coordinators ☾ ability to collaborate and collect information.
  - STEM timetabled for 1 session per week.
  - Purchased several technologies to compl3ment learning.
    - Tech is rotated through school on a term by term basis
    - This enables students and staff to build expertise.
  - Increased collaboration and improved planning (amongst staff).
  - Focus on Design in Terms 1 and 2 ☾ Implementation in Terms 3 and 4.

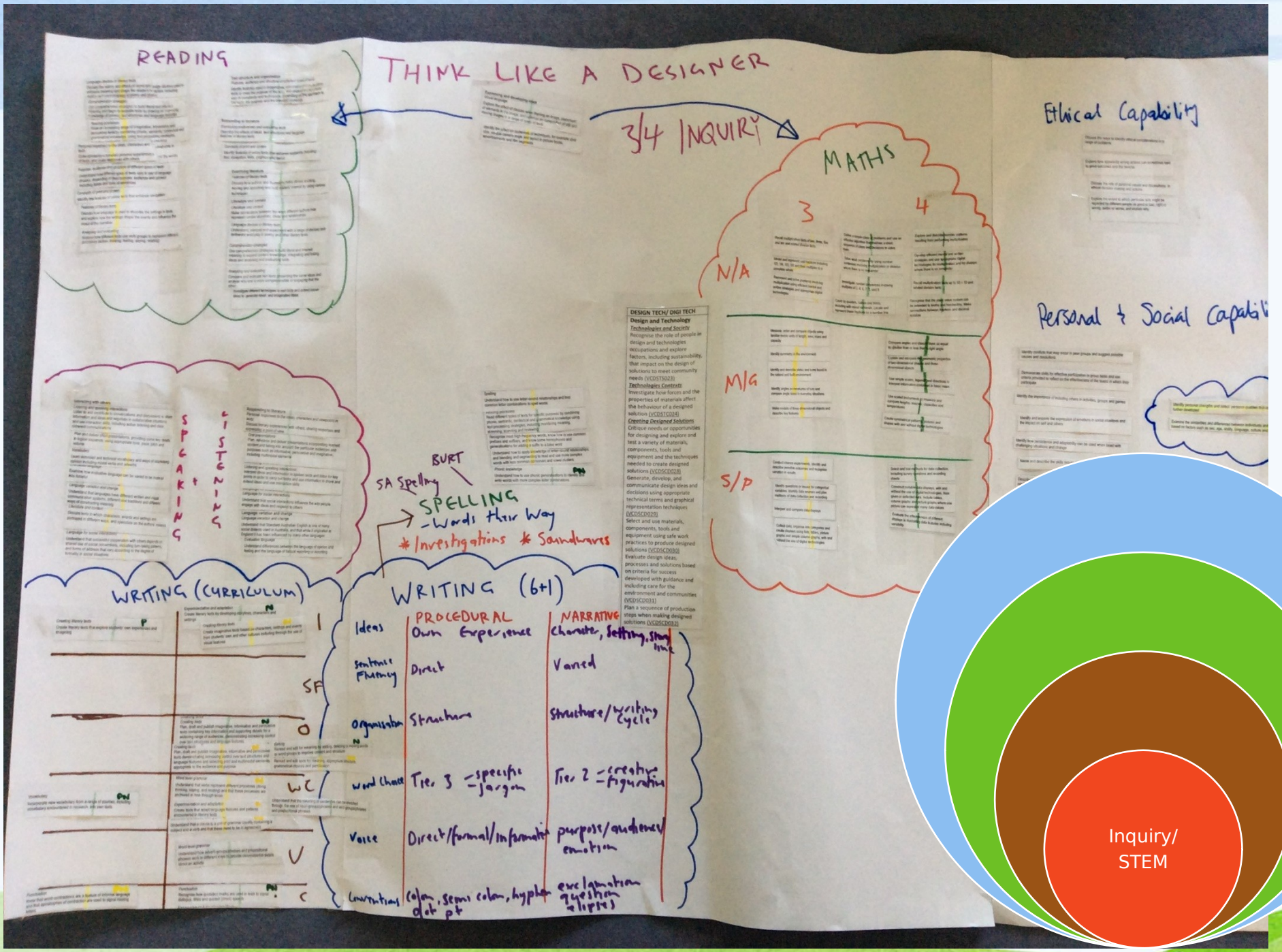
STEM @ BPNPS (STEM & Technology)

- Purchased several technologies to complement learning.
- Rotated throughout the school on a termly basis.

STEM @ BPNPS (Pedagogy)

- Inquiry driven curriculum – use of Science & Humanities curriculum to lead/guide maths and literacy.

- This:
  - allows us to teach ‘through’ an activity instead of ‘to’ an activity.
  - ensures patience through the curriculum.
    - allows time to figure out what the students **NEED** and what will benefit the whole school.
  - allows students to make connections and explore topics in depth.

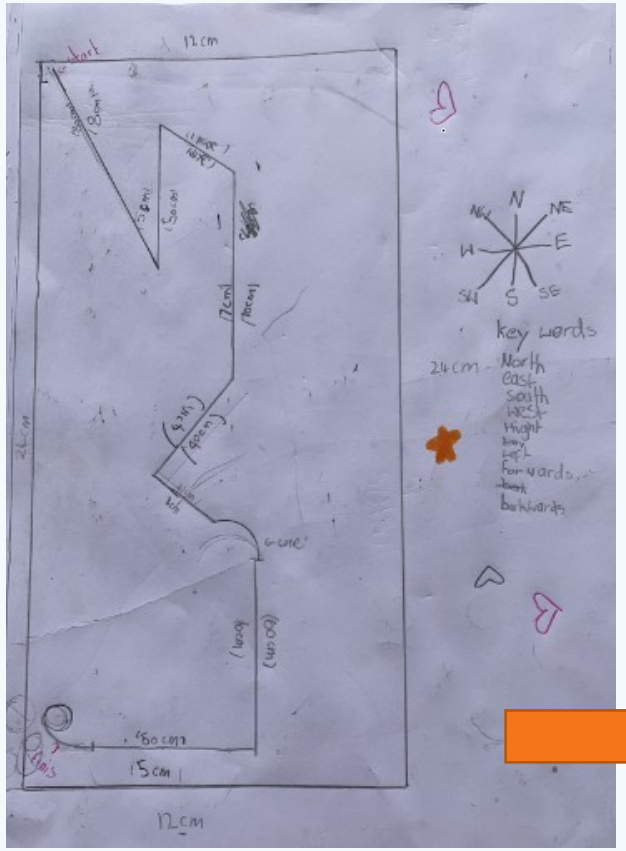


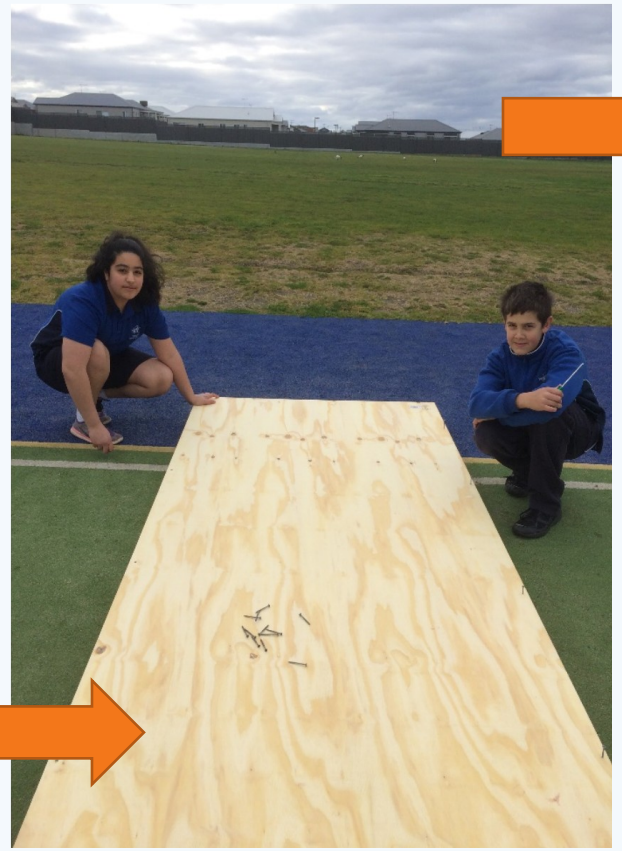
DESIGN TECH/ DIGI TECH
Design and Technology
Technologies and Society
Recognise the role of people in design and technologies occupations and explore factors, including sustainability, that impact on the design of solutions to meet community needs (VCDSTS023)
Technologies Contexts
Investigate how forces and the properties of materials affect the behaviour of a designed solution (VCDSTC024)
Creating Designed Solutions
Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to create designed solutions (VCDSCD028)
Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques (VCDSCD029)
Select and use materials, components, tools and equipment using safe work practices to produce designed solutions (VCDSCD030)
Evaluate design ideas, processes and solutions based on criteria for success developed with guidance and including care for the environment and communities (VCDSCD031)
Plan a sequence of production steps when making designed solutions (VCDSCD032)

STEM @ BPNPS (In Practice)

- Interconnectedness between the curriculum – true Inquiry!
- Golf Course, Pinball Machine and Sphero Maze projects.
- Learning processes (with outcome in mind) are the clear centre point to these projects.
- Technology then used to engage, foster exploration and innovate within tasks.

For example:
Design project – construct project –tech then complements learning



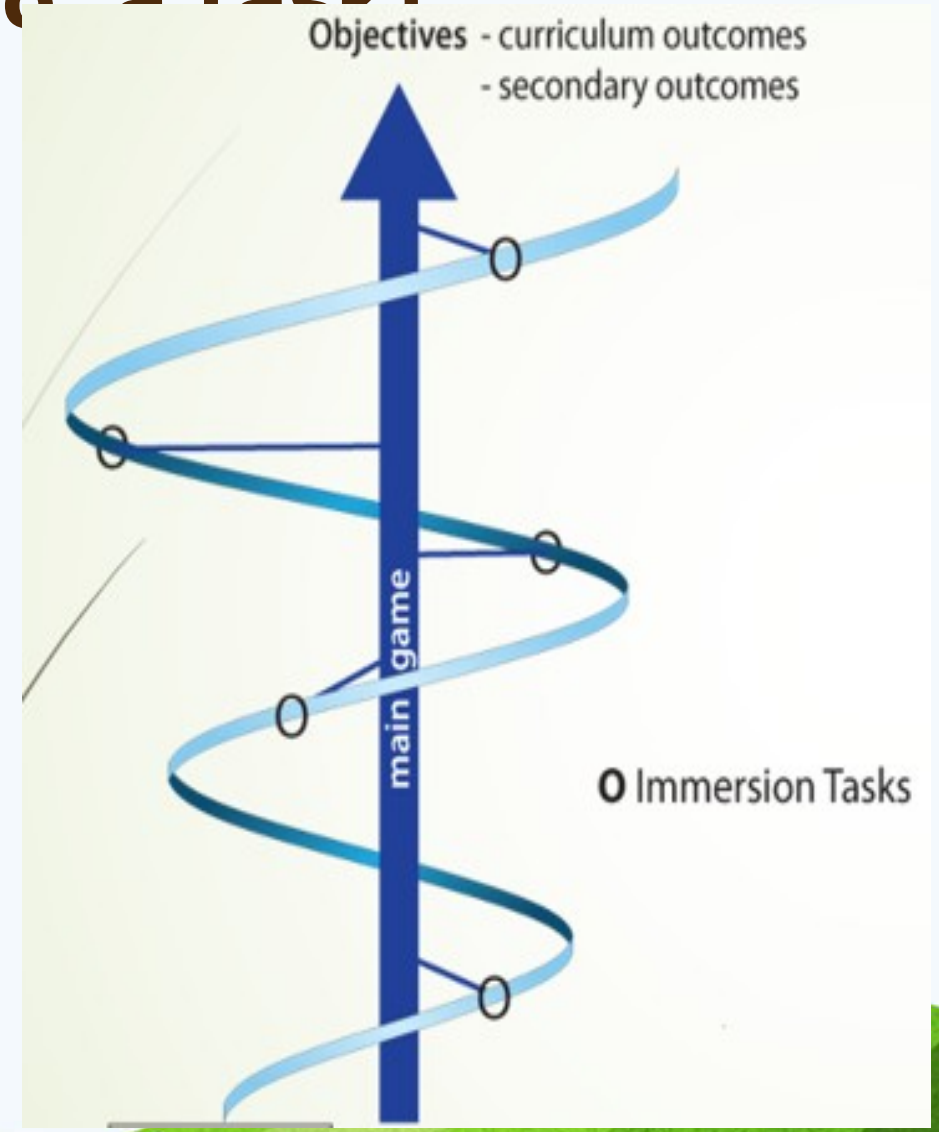


STEM @ BPNPS **(‘Through <u>NOT</u> To’ a task)**

For example:

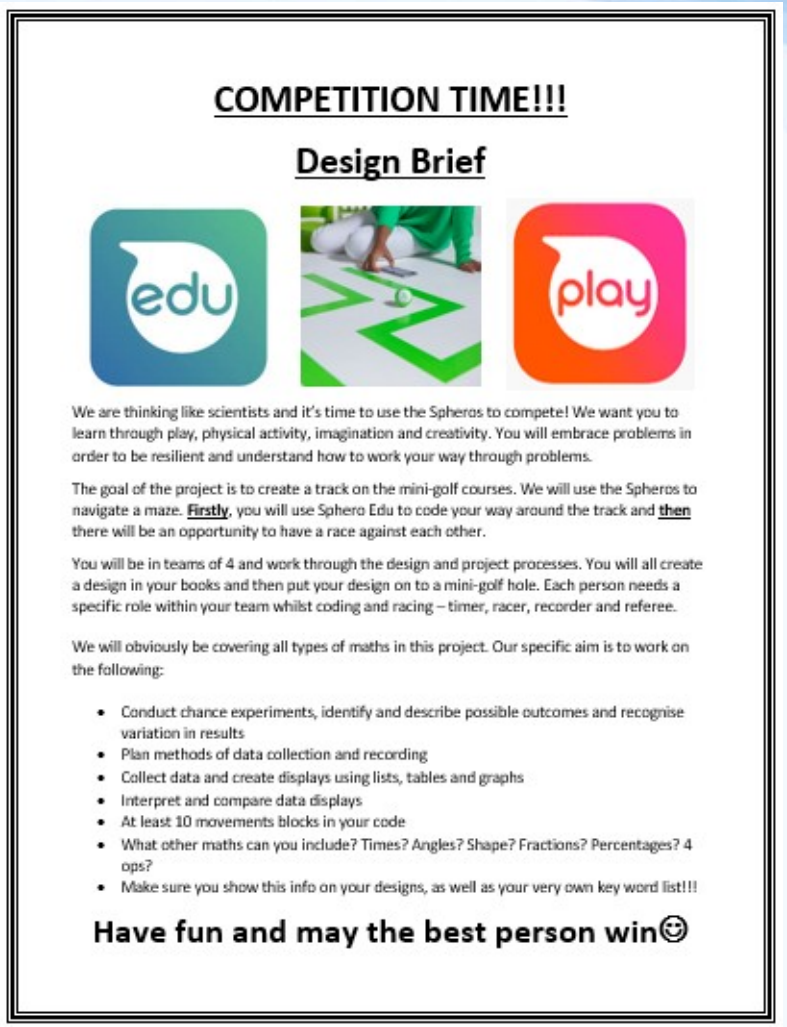
There is a clear objective but several ways to get there. ‘Touch’ points are vital throughout but curriculum knowledge is a key for discussion.

Touch points throughout this project were seen through maths, reading and writing, as well as team work, collaboration and problem solving.



STEM @ BPNPS

- Key Ideology:
  - Decision making and problem solving (key skills for life and education)
  - Teamwork and collaboration (also central themes to life) – open the door for students!!!
- Design Briefs:
  - essential tool for project learning.
  - Allow students (and teachers) to focus on the ***process.***
  - Allow us to teach 'through' tasks, not 'to' tasks!!!



COMPETITION TIME!!!

Design Brief

We are thinking like scientists and it's time to use the Spheros to compete! We want you to learn through play, physical activity, imagination and creativity. You will embrace problems in order to be resilient and understand how to work your way through problems.

The goal of the project is to create a track on the mini-golf courses. We will use the Spheros to navigate a maze. **Firstly**, you will use Sphero Edu to code your way around the track and **then** there will be an opportunity to have a race against each other.

You will be in teams of 4 and work through the design and project processes. You will all create a design in your books and then put your design on to a mini-golf hole. Each person needs a specific role within your team whilst coding and racing – timer, racer, recorder and referee.

We will obviously be covering all types of maths in this project. Our specific aim is to work on the following:

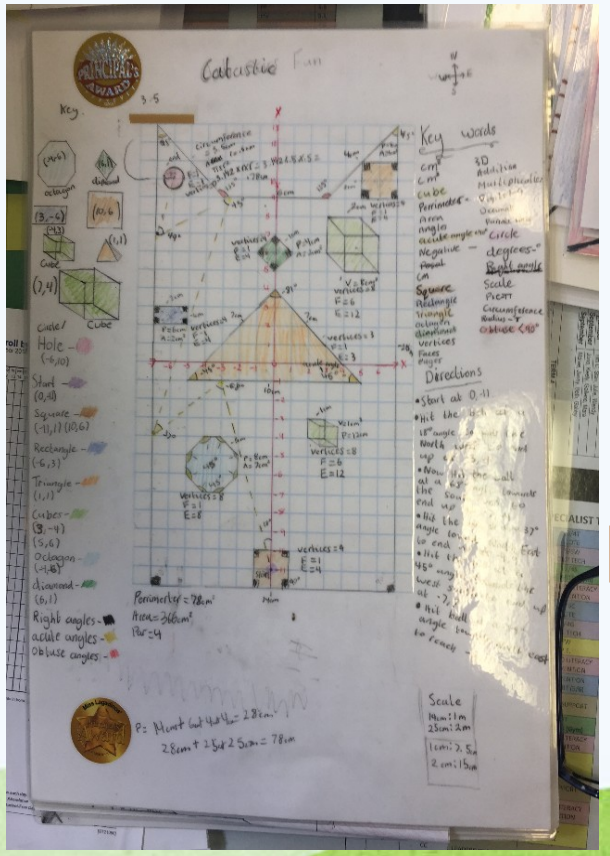
- Conduct chance experiments, identify and describe possible outcomes and recognise variation in results
- Plan methods of data collection and recording
- Collect data and create displays using lists, tables and graphs
- Interpret and compare data displays
- At least 10 movements blocks in your code
- What other maths can you include? Times? Angles? Shape? Fractions? Percentages? 4 ops?
- Make sure you show this info on your designs, as well as your very own key word list!!!

Have fun and may the best person win☺

"Why would you tell a student something that they could work out for themselves – if you set up the opportunity" – Rob Vingerhoets

STEM @ BPNPS (Evolution of a Task)

2016/2017
Mini-Golf:
‘Design’ Project

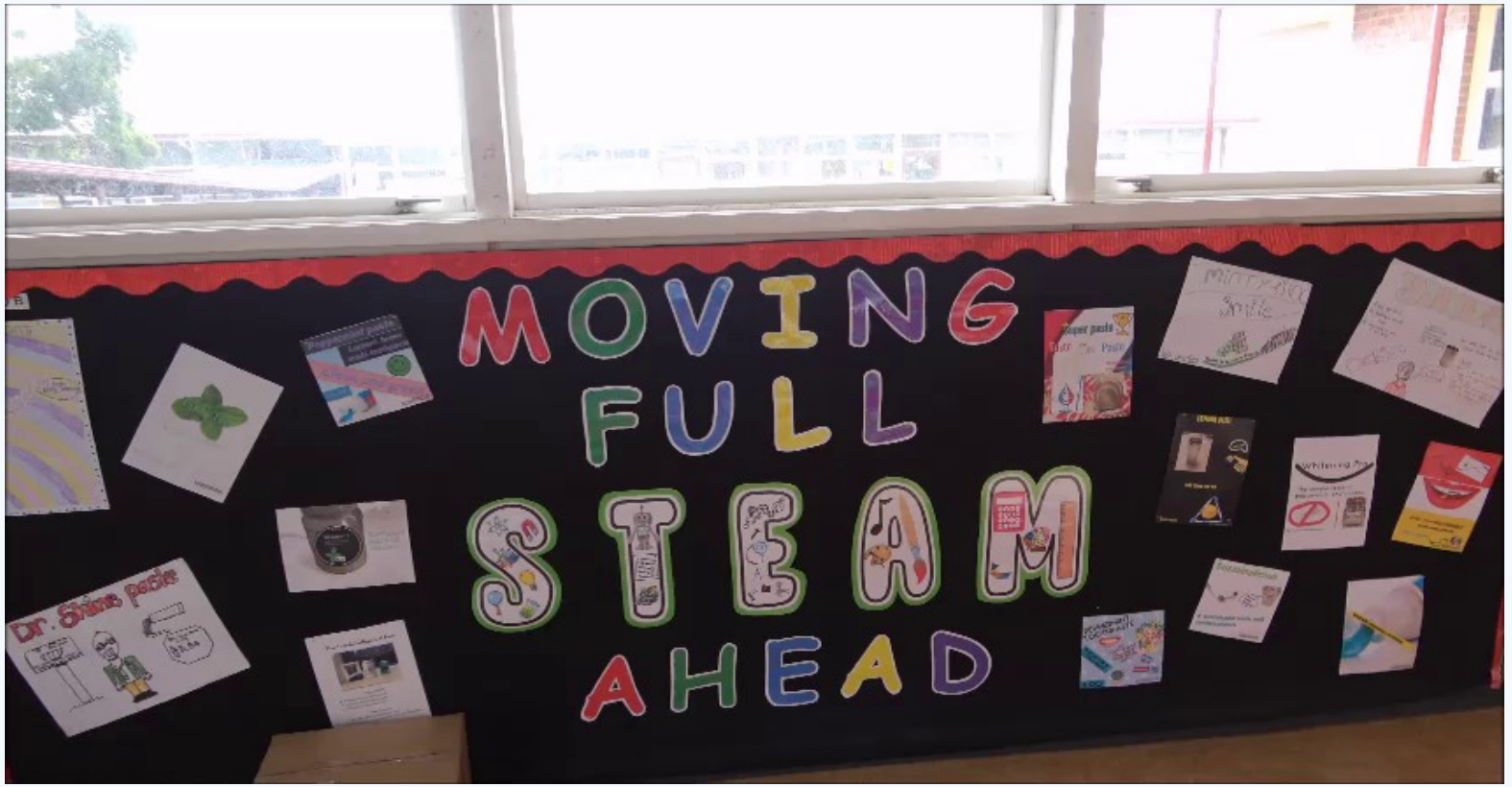


2018
Mini-Golf: Design,
Construct & Play

2019
‘Sphero’ Maze:
Code & Collect

These types of projects certainly help with this…

Where we come from... Rollins Primary

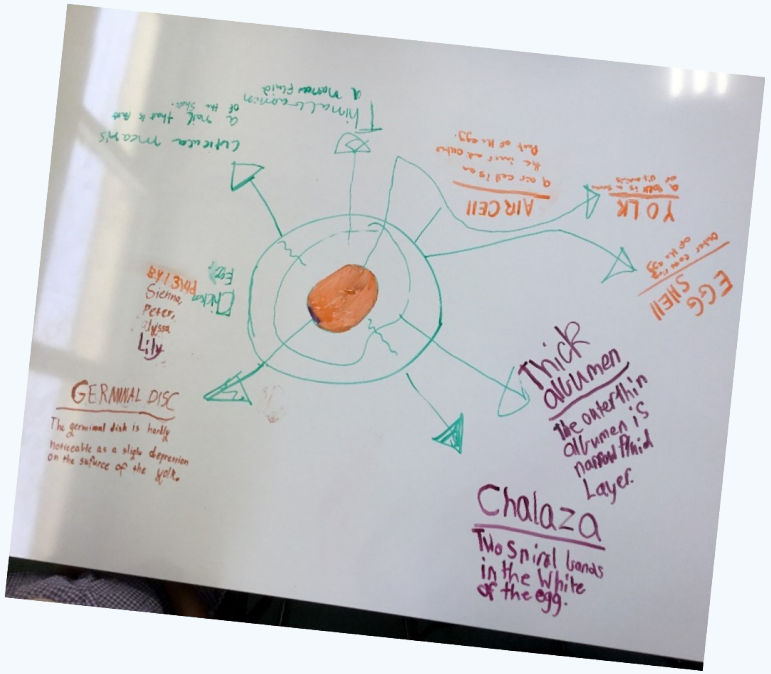


Rollins Primary School interpretation of STEM

- STEM has been running for 18 months: Arts added this year
- Topics based on inquiry and is driven by a problematic question
- STEAM runs as a specialist class
- Long term goal: embed STEAM in classroom with cross curricular links
- Driven mainly by Principal and STEAM teacher
- Funding in 2018: enabled us to buy resources to re-design a classroom dedicated to STEM
- Teacher acts as a facilitator to encourage creativity and entrepreneurial skills ☾ never show a final product or directly answer a question
- Value relationships and collaboration within the SEPS community

ROLLINS
PRIMARY SCHOOL
REACH

At Rollins, our aim is to apply STEM as *‘a way of thinking, not just a subject’*



Inquiry Topic

Maths

Using units of measurement Connect volume and capacity and their units of measurement (VCMMG225)
Connect decimal representations to the metric system(VCMMG222)

Money and financial mathematics
Investigate and calculate percentage discounts of 10%, 25% and 50% on sale items, with and without digital technologies (VCMNA218)

Fractions and decimals Add and subtract decimals, with and without digital technologies, and use estimation and rounding to check the reasonableness of answers (VCMNA214)

Science

Science as a human endeavour Scientific understandings, discoveries and inventions are used to inform personal and community decisions and to solve problems that directly affect people's lives(VCSSU073)

Analysing and evaluating Suggest improvements to the methods used to investigate a question or solve a problem (VCSIS087)

Chemical sciences Solids, liquids and gases behave in different ways and have observable properties that help to classify them (VCSSU076)

Technology

Technologies and Society
Investigate how people in design and technologies occupations address competing considerations, including sustainability, in the design of solutions for current and future use (VCDSTS033)

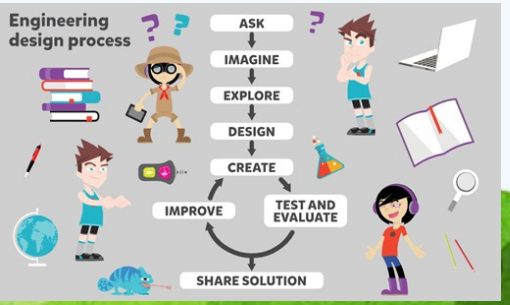
Arts

Present and Perform Create and display artwork considering how ideas can be expressed to an audience (VCAVAP031)

Rehearse and perform songs and music they have learnt, including their own compositions, combining aspects of the elements of music and using performance skills, to communicate ideas and intentions to an audience (VCAMUP031)

Engineering

Producing Apply safe procedures when using a variety of materials, components, tools, equipment and techniques to produce designed solutions(VCDSCD040)

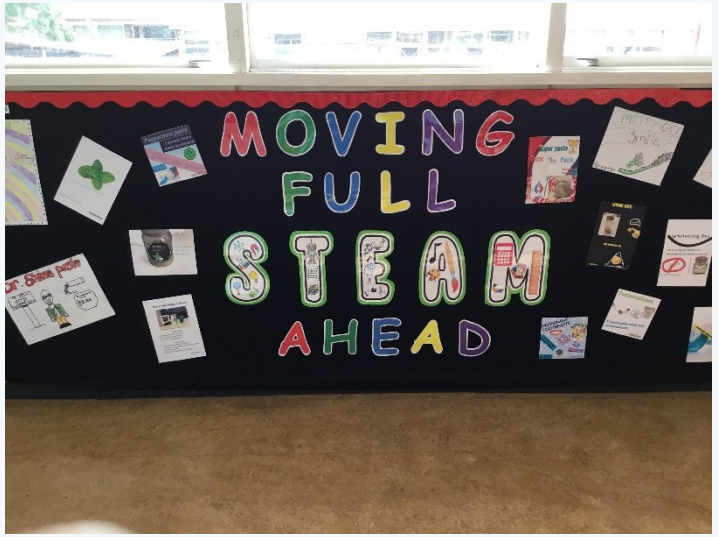


Full STEAM Ahead at Rollins PS

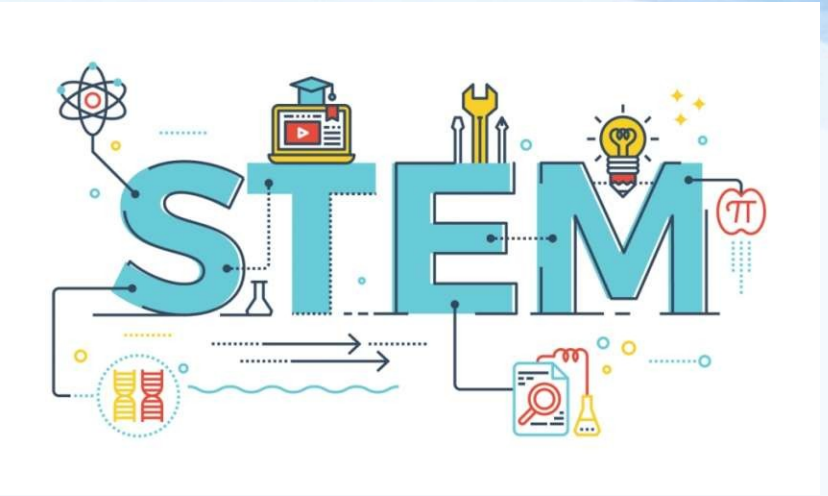
At Rollins PS, STEAM is:

- inquiry driven and links in with the Victorian Curriculum
- used as a supportive tool for enhancing classroom learning for Inquiry and literacy for each year level (P-6)
- promoted as a ‘way of thinking’ with real world connections and links to careers
- the vehicle for hands on activity that inspires students to be creative and ***enjoy*** their learning in the sciences and maths
- including industry and specialists to share in the educational experience

Our aim is to inspire students to aspire for careers in STEM



Where to from here?



- Department Level Meetings (Sharing)
- Principal Class Meetings (Developing)
- Strengthening Geelong STEM Network (Embedding)
- Further Improving Teaching Practices (Engaging)
- Push for increased STEM participation in early years (Revolutionising)
- Primary Focussed Tech Schools (Dreaming!)

Deakin University have received further funding for a SEPS 2.0 Group (Building)

Thank you and if you would like any further information please feel free to contact us...

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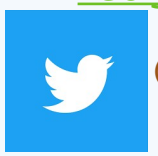
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