showcase08
AWARDS FOR EXCELLENCE IN SCHOOLS

State Award Submission Cover Sheet

Title of submission: *"Dirty Mathematics"* - a problem solving curriculum achieving quality outcomes and continuous improvement for students studying Mathematics

School/s: Sandgate District State High School

District: Brisbane North

Region: Greater Brisbane

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Please nominate the Showcase category for your project. Please nominate one category only. (See section 1.2 of the guidelines for more information.)

	Showcase Award for Excellence in the Early Phase of Learning
X	Showcase Award for Excellence in the Middle Phase of Learning
	Showcase Award for Excellence in the Senior Phase of Learning
	Showcase Award for Excellence in Inclusive Education
	Showcase Award for Excellence in Leadership
	Showcase Award for Excellence in Innovation
	Showcase Award for Academic Excellence
	Showcase Award for Excellence in Community or Industry Partnerships

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OPTIONAL multimedia items:
(For further information see guidelines appendix L)

If included, please nominate (✓) ☑

To be supplied on one compact disc with the hard copy. Multimedia items are not required electronically.

- Submission required in hard and electronic copy
- Maximum five pages of submission information and 10 pages of appendices (excludes the cover sheet and project summary)
- Minimum font size of 11 points
- Multimedia material optional

For further details see guidelines section 3 – How to enter.

SIGNATURE/S OF PRINCIPAL/S

_____

Date

_____

To be completed by the Executive Director (Schools) after completion of the checklist:

I support this submission and its entry in the Showcase Awards for Excellence in Schools 2008. This submission meets the requirements set out in the Executive Director's Checklist.

Signature of Executive Director (Schools) **Date**

_____ _____

Submission overview*: Murder, Espionage, Risking Taking and Dirt ……..*
Students get their hands dirty, literally, by dealing with problem solving projects using Mathematics as a research tool in an Action Research setting. This involves a problem solving curriculum approach in Years 8 and 9 as well as a transition from Year 10 to the senior levels of Mathematics. Students consider a problem (a 'seed'), formulate their own hypothesis, design their own data gathering procedures, analyse their data, draw conclusions, evaluate their hypothesis and make recommendations. The project 'seeds' are drawn from across the curriculum (Mathematics, Science, Study of Society and the Environment, Manual Arts, Human Movements) to show the wide use of Mathematics as an investigative tool.

Description*: OUR SUCCESS BEGINS*
Leading up to 1999, we were becoming increasingly concerned that our Middle Schooling Mathematics Program was not meeting the needs of our students. Students had been arriving in Year 8 with more diverse levels of ability, with fewer students achieving in the top percentiles. Performance in the senior school was not as good as we thought it should be. These overall results were historically similar to other schools and, although similar, were not good enough. This raised the question 'Why was this happening at our school?' Through teacher observation, parent and student feedback, a detailed study of syllabus requirements and discussions with regional mathematics advisers and personnel from the Queensland Studies Authority, the major factors contributing to this decline in performance were identified as the disparity in demands between the Middle School and Senior syllabi and the learning experiences provided being no longer applicable to the changed clientele.

To address this situation a long term strategic view was undertaken to plan a cohesive and seamless transition for students to advance through Mathematics Year 8 to Year 12. We used an Action Research model to determine: 'What was 'it' our students needed to be able to do after 3 years to ensure their successfully transition from Year 10 to Years 11 and 12? How could the ground work be laid in the middle school for a student to be successful in their senior years in Mathematics? Where there any changes required in our pedagogical practice? How could we measure success or failure to ensure that we were not only on the right track but also to ensure we maintained an objective and impartial assessment of our plan? Were our resources adequate and finally, how could we evaluate of our program to ensure its continual success through its evolution?'

In 1999, we researched, attended professional development activities, we consulted with our cluster schools and, most importantly, with our community. The result - a developmental problem solving and investigation based program with strong connections to the real world. Dirty Mathematics was born. Although un-named at this stage, it presented great challenges. Our research, planning and foresight has since been reinforced with the introductions of the "1-10 Mathematics Syllabus" and the current Queensland Curriculum, Assessment and Reporting (QCAR) Framework which also adopt a similar approach to ours.

Dirty Mathematics into actions - the current state of play
(Additions to our strategic and operational responses are provided in **Appendix 1, Page 6**)

While Dirty Mathematics focuses on Middle Schooling initiatives, it takes a long term, developmental view of enabling our students to exit school with the best possible preparation for post-secondary destinations and with expanded options. We take our students, from their arrival in Year 8, on a journey of exploration culminating in their final studies at the end of Year 12. The evidence indicates that our developmental approach does indeed achieve quality and continually improved outcomes for all our students.

The 'it'
Backward mapping from the Senior Syllabi to the Middle School syllabus links the skills required for Years 11 and 12 to those covered in the Middle School with any gaps being filled in with our own determinations. These links form the cohesive and seamless framework for our program. The recent scan linked the QCAR Framework's "Ways of Working" (See **Appendix 2A, Page 7**) to the current Senior Mathematics courses.

The ground work for student success
Dirty Mathematics begins in Year 8 with the development and solution of problems being designed as a transition from the Year 7 Essential Learnings to the Year 9 Essential Learnings. The

development continues in Year 9 with the focus on the Year 9 Essential Learnings and moves into Year 10 focusing on transitioning students into the senior school studies of Mathematics. Dirty Mathematics integrates history, people, places, spies, espionage, intrigue, murder, politics, taking risks, discussion, communication, planning, designing, creativeness, satisfaction, fun, working together and taking pride in excellence. It is centred on the four generic problem solving and project frameworks, viz. "*Planning"*, "*Designing"*, "*Investigating what is…."* and "*Evaluating the use of mathematics in…".*(See **Appendix 3, Page 8**) Projects are cross-curricular and are drawn from Mathematics, Science, Study of Society and Environment, Manual Arts and Human Movements.

Each task is planned using a *front ended assessment* approach. Here the assessment is developed at the same time as decisions are made on the content, procedures and process skills to be developed and the learning experiences to be provided. All the required general literacies and the subject specific literacies are explicitly listed and integrated in to the learning experiences to be provided. To supplement the development of the higher level thinking and problem solving skills needed to complete the task, students are given investigations and practical work based on the theme used for the task. (See **Appendix 4, Page 9**) All decisions and resources are documented into a Task Plan accessible by all teachers.

Pedagogical Practice

Dirty Mathematics operates with innovative and engaging pedagogical practice. The 'topic by topic' approach is replaced by the thematic designs supplemented by engaging investigations and activities to stimulate and appeal to the enquiring mind and to stimulate discussion and argument among the students. This discussion engages the students and the engagement encourages learning.

More hands on practical activity work, getting dirty with mathematics – using instruments, 'playing' with materials, playing with and in dirt, allowing the creativity of **all** students to come through - getting **all** students doing and being physically engaged to have their minds participating.

Emphasis is placed on more explicit use of Productive Pedagogies, principles of Brain Based Learning and the integration of ICT in meaningful contexts. All student work is moderated against the QCAR Standards via teacher's discussion of, and comparison of grades awarded.

Resourcing

The framework and groundwork defines our physical resource needs. Requirements for each project are identified. If current resources are not adequate, the materials are purchased. What we cannot purchase, we make. Our teachers are also valuable resources. To utilize their experience, ideas and creativity, Year coordinators organize fortnightly/monthly meetings. At these meetings, teachers discuss the learning experiences that need to be provided to meet the range of student needs, provide in-service for new staff, identify professional development needs, identify any further requirements needed to successfully deliver our program, provide feedback to the staff for full staff discussion and make recommendations for improvements to achieve further success.

Measuring our significant and long term success

In the 'short term', we compare each student's Semester Report grade against previous Report grades and against two baseline measures - the State based Year 7 Numeracy Test results and the results of Australian Council for Educational Research's Progressive Achievement Tests in Mathematics (PAT Maths) which is administered to all our students at the start of Year 8. 'Long term', we compare students' exit results against District and State data as available through the Corporate Data Warehouse. These comparisons give objective and impartial information upon which to base judgements on the success or failure of Dirty Mathematics in providing the ground work for success in Mathematics. Teacher observation also provides information for consideration.

Evaluation of our program

Our Research Action cycle involves an objective and impartial, annual evaluation. Strategic and operational issues are examined and refinements undertaken. As an example, Sandgate District State High School initiated, facilitated and led a Bramble Bay Cluster activity assessing ways of implementing the Mathematics Syllabus. It involved Administrators and Key Teachers from local primary and secondary schools, meeting twice per term. The key focus of the group was sharing of professional practice in the implementation of the new syllabus, the investigative approach and "how we are doing it" in our classrooms and professional dialogue on continuity of expectations from Year 7 to Year 8 and to better support the transition from Year 7 to Year 8.

Connection to QSE – 2010 (2006 – 2008; Revised 2007) and Education and Training Reforms for the Future

Dirty Mathematics	Links to	2010/ETRF Outcomes
Each task for the Dirty Mathematics is planned and written using our whole school literacy approach of *front ended assessment* to develop general and subject specific literacy. Dirty Mathematics facilitates the development of higher numeracy and mathematical skills, and achieves quality outcomes and continuous improvement for all our students. It provides all our young people with the opportunity to develop deep knowledge and understanding of mathematical concepts and processes, to participate in substantive mathematical discussions and conversations, to develop initiative in deciding on their own direction for research and to recognise the contributions various cultures made to the development of mathematics. It provides the explicit and scaffolded teaching they need for success in schooling and beyond, support for all students through team work and networking of teacher and students; it maintains a high quality of academic engagement and outcomes, helps students recognise and understand the interdependence of mathematics and other curriculum areas through the integration of knowledge and connecting the problems to real world contexts. Dirty Mathematics is structured across the Middle Phase of Learning within the QCAR Framework and is supported by, and encourages the integration of ICT in meaningful contexts catering for the full range of student abilities to help students become lifelong learners. Transition between years of schooling is also assisted by contact with feeder schools through Bramble Bay Cluster activities. All material developed at Sandgate High is stored on the teachers' common computer drive. It is available for all to access, modify, use and update as required. Presentation of aspects of the program at Head of Department cluster meetings, TAFE Teacher Conferences. Provision of examples of our work to the QSA working group implementing QCAR for use as exemplars. Cooperative alliances and planning processes with primary schools and Special Education Unit.	***** Whole school literacy/numeracy planning process with a renewed focus on literacy and numeracy in the curriculum. ***** Improved learning outcomes for all students by continuing to address principles of: **>>**Inclusive Education implementing Queensland Education Adjustment Program; The Education Adjustment Program; Embedding Aboriginal and Torres Strait islander perspective in schools; Implementing the Framework for Gifted and Talented. ***** Every student in Years 8 -9 is: **>>**Engaged in purposeful, intellectually challenging learning; Provided with opportunities to achieve success; Supported in their transition from year to year and from primary to secondary education. ***** Implementing QCAR ***** Embedding the use of ICT as an integral component of teaching, learning and assessment. ***** Participate in communication strategies, to enable sharing of best practice in curriculum and teaching across the phases of learning. ***** Support student transition through the learning continuum. ***** Cooperative alliance, planning processes.	**LE1**: Improved learning outcomes for the diverse range of students in Education Queensland schools. **LE2**: Improved integration of curriculum, teaching, assessment and reporting through a framework that engages our diverse range of students. **SC1**: Schools have innovative and distinctive strategies responsive to student needs. **ETRF: Middle Phase of Learning State School Action Plan:** Redefined curriculum; focus on literacy/numeracy skills; Differentiated, high-quality teaching methods that responds to the student diversity; promote deep learning; Interacts with teachers who are prepared to meet the distinctive and diverse needs of students during early adolescence.
Access to relevant Professional Development activities; Year Coordinators; Year group planning, implementation and evaluation and peer support creates a pathway for succession planning and the continuation of the program's success.	**WO1:** A workforce that has the capability and flexibility to deliver the strategic objectives of the department through ongoing professional development opportunities	

OUTCOMES: As a result of our students participating in Dirty Mathematics, students have:

Data measured outcomes	*Teacher observations*
Improved performance of students by the end of Year 8 when compared to all baseline data measures. **Continued improvement in performance of students.** **Improved performance of students identified with learning difficulties or physical impairment when compared to all baseline data.** **Continued improvement of these students.** **Improved performance of students identified in the Year 7 Test as being 'Under the National Benchmark'.** **Improved performance of identified ATSI students in Year 8 compared with baseline data and continued improvement.** **Improvement and continued improvement in earlier cohorts – Historical Year 12 Exit results**	**Increased engagement of students in their learning and increased student control over their learning.** **Increased comprehension and problem solving levels.** **Re-engaged staff and re-vitalised involved in professional conversations about increased ways of using Information and Communication.**

EVIDENCE: The evidence suggests we are achieving quality outcomes and continuous improvement for all students studying Mathematics (See **Appendix 6, Page 11** for more detailed data). Our curriculum is highly **innovative**, **engaging**, **sustainable** with resources developed for all to use, **inclusive** of all students, providing valuable adjusted learning/assessment opportunities as required, and is **easily transferable** - no special resources are needed.

Improved performance of students by the end of Year 8 when compared to all baseline data measures

At the start of Year 8-2007, baseline data indicated that **53.5%** of students rated a C Grade or higher on the Year 7 Numeracy Test. The PAT Maths scores indicated **38.1%** of students were rated C or higher. At the end of Year 8, having completed the first year of Dirty Mathematics, **90.3%** of students gained a C grade or higher. (Student population, n = 273):

At the start of Year8-2006, baseline data showed **54.7%** at a C grade or higher on the Year 7 Numeracy Test with **35.9%** at a C grade or higher on the PAT Maths test. After the first year of Dirty Mathematics, **80.4%** achieved a C grade or higher. (Student population, n = 271)

Continued improvement in performance of students

The Year 8/2006-Year 9/2007 cohort also showed an increase in performance from Year 8 to Year 9 with results improving from **80.4%** in Year 8(n = 271) to **83.7%** in Year 9 (n = 268).

Improved performance of students identified with learning difficulties or physical impairment when compared to all baseline data.

Students with learning difficulties are classified as **T1** – chronological reading age 1 year or less (needing minor changes to class work and the monitoring of performance), **T2** –reading age 3-4 years behind peers (needing significant assistance from classroom teacher) and **T3** – reading age 4 or more years behind peers (requiring modification of learning materials and assessment and Support teacher assistance).

For the 2007 Year 8 cohort, students in all classifications show a significant improvement in performance at the end of their first year of Dirty Mathematics with:

- 88.8% T1 achieving a C grade or higher, n = 11
- 69.3% of T2 students achieving a C Grade or higher, n = 13
- 50% of T3 students achieving C or higher, n =10

Without the intervention of Dirty Mathematics these student would have been gaining D or E grades, as indicated by baseline measures.

Continued improvement of these students through Years 9 and 10
For the Year 9 2006 cohort the data shows a continued improvement through the second year of Dirty mathematics compared to their first year:

- **46.7%** T1 achieving a C grade or higher in Year 8 and **78.6%** in Year 9, an increase of **31.9%,** n = 17
- **68.8%** of T2 students achieving a C Grade or higher and **81.3%** in Year 9, an increase of **12.5%,** n = 16
- **50%** of T3 students achieving C or higher and **85.7%** in Year 9, an increase of **35.7%**, n = 10

Without the intervention of Dirty Mathematics these student would have been gaining D or E grades.

Improved performance of students identified in the Year 7 Test as being 'Under the National Benchmark'
Year 8 2006: **65.5%** achieved a C grade or higher, n = 29; Year 9 2007: **69.2%** achieved a C grade or higher, n = 26; Year 8 2007: **79.5%** achieved a C grade or higher, n = 39

Improved performance of identified ATSI students in Year 8 compared with baseline data and continued improvement through Year 9.
Having completed their first year of Dirty Mathematics at the end of 2006, the majority of students (5 of the 9) were performing at or above Year 7 Numeracy and PAT Maths grades. After consultation with our Aboriginal Liaison Officer, some modifications were made to the content, delivery process and assessment process to accommodate indigenous culture. The result showed a pleasing improvement. Of the nine indigenous students in the 2007 Year 8 cohort, all achieved above baseline data expectations. A similar improvement was seen in the Year 9 cohort.

Improvement and continued improvement in earlier cohorts – Historical Year 12 Exit results
The data for earlier cohorts has been expressed using the Year 12 Exit Results from 2003 to 2007. This represents the progress of the 2000, 2001, 2002 and 2003 Year 8 Cohorts compared to the 'old style' 1999 Year 8 Cohort. This shows the long term success of our approach. These results are validated through the Queensland Studies Authority's Quality Assurance procedures. Over interval 2003 to 2007, data shows a continuous improvement in performance of our students when compared to *Like Schools* data. . From being positioned **lower to middle '*Similar*'** band in the Like Schools **STATE** data, our students, after participating in Dirty Mathematics, now exit Year 12 consistently in the **lower to middle '*Higher than*' STATE** band. Also, District data shows that in 2007, our **Mathematics A** cohort performance was the **best in the district** and for **Mathematics B and Mathematics C** our performance placed us as the **second top school** respectively in the district. This represents a consistent high performance by all our students. Preparation through Dirty Mathematics **is** providing the ground work for significant success in long term performance levels. (See **Appendix 7, Page 13, Laying the Groundwork For Success**)

Increased engagement of students in their learning and increased student control over their learning.
Students often ask if they can do extra investigation. All encouragement is give. Example, when doing the rainforest light study, a group of students asked if they could also examined the intensity of light reaching the floor of the forest over a certain area. Go for it was the replying. This reflects an increase in confidence in their own abilities and in risk taking.

Increased comprehension and problem solving levels
Students display improved comprehension and problem solving ability as they progress through the themes. Initially guidance is given in analysing a problem with discussion of the problem being guided by the teacher. Over subsequent tasks, this scaffolding is slowly removed until students decide on how they will investigate the problem. For example, when given the topic "which mulch is best?', students initiated a discussion on what was meant by the term 'best'. They defined this term according to their own interests and proceeded to investigate the problem accordingly. 'Best' to some meant 'lower temperature' while 'best' to others meant 'higher moisture contained in the soil'. They then designed and carried out their individual investigations accordingly.

Re-engaged staff re-vitalised professional conversations
More staffroom and Faculty conversations are centred around ideas for other Themes or ways of extending of making the current Themes more engaging and challenging.

OUR SUCCESS CONTINUES

OTHER DOCUMENTATION:

CONTRIBUTING PERSONNEL: ***Head of Department*** Andrew Foster, ***Senior Teachers*** Nadine Benjack, Peter Cocks, Lyn Hancock and ***Teachers*** Peter Veretennikoff Peter, Trappett Alex Carter, Alison Turner, Kylie Andrews, Rob Lucas, Garry Pashen

APPENDICES:

Appendix 1: Additions to our strategic and operational responses.

The 'it'
The QCAR Framework also specifies the Essential Learnings to be covered at key junctures and they are written in such a manner that links content to the development of higher levels of thinking

The ground?
Each task is defined succinctly. The specific general literacy addressed in the task is described. Students are given a list of mathematical vocabulary needed and the list is discussed and expanded upon via literacy based activities. Through these activities students are introduced to the Clever Connectives (See **Appendix 2B**, **Page 7**). Advice is also given regarding the desired format of the response and how the report should be structured e.g. Powerpoint, poster etc. The task specific criteria sheet is written in terms of the QCAR standards and discussed with the students

Our pedagogical practice?
We place a greater emphasis on and more explicit use of Productive Pedagogies to:

- develop deep knowledge and understanding of mathematical concepts and processes
- encourage students to participate in substantive mathematical discussions and conversations
- allow students to develop initiative in deciding on their own direction for research
- provide support for all students through team work and networking of teacher and students
- maintain a high quality of academic engagement and outcomes
- help students recognize and understand the interdependence of mathematics and other curriculum areas through the integration of knowledge and connecting the problems to real world contexts
- recognise the contributions various cultures made to the development of mathematics
- develop general and subject specific literacy skills as directed by our whole school literacy approach

The principles of Brain Based Learning focused on include movement to produce pro-learning chemicals within the brain, discussion, novelty, fun, challenge and creativeness.

Information and Communication Technologies have been integrated into the themes in meaningful contexts. Students are actively involved in planning and executing all stages of the research. Having formulated a hypothesis and what data is required to evaluate the hypothesis, data is collected through the use of stand alone graphics calculators, through a range of sensor probes connected to the graphics calculators and through photographic records. The data is recorded either on graphics calculators which is later digitally downloaded to Excel spreadsheets for presentation and further analysis, or directly into teacher prepared spreadsheet templates or student generated templates. Reports are presented in a variety of formats including written reports, models, PowerPoints and/or, multimedia presentations.

Resourcing?
Teachers were released from classes at various times to evaluate, develop, adapt and make resources and materials. We have shared our ideas through presentations at cluster meetings, provided samples of our work and our student response to the QCAR Team in the developmental phases of QCAR and presented at TAFE (Technical and Further Education) Colleges' teacher conferences.

Measures?

All use different scales so boundary lines we developed to provide a common comparative baseline. The spreadsheet profile Year 7 Literacy and Numeracy Test data, performance compared to benchmarks, learning needs, ATSI information, and semester results from Year 8 to Year 12.

Common Scale('C' being 'Sound Achievement')	A+	A	A- to B+	B to C+	C to C-	D+ to D-		E+ to E	E-
School Results	A+	A	A- to B+	B to C+	C to C-	D+ to D-		E+ to E	E-
PAT Maths	9	8	7	6	5	4	3	2	1
Year 7 Tests	900+		750+	700+	650+	600+		500+	400+

Evaluation?

The Administrators included Principals, Heads of Department(Secondary) and Heads of Curriculum(Primary). The Cluster Group included Bramble Bay Group, comprising of Sandgate District SHS, Sandgate SS, Bracken Ridge SHS, Boondall SS, Nashville SS, Norris Road SS, Shorncliffe SS, Brighton SS, Bald Hills SS, Zillmere SS, Taigum SS, Nudgee Beach Environmental Education Centre. Resources developed were made available on CD.

Appendix 2A - Ways of working

- ✓ **Analyse situations to identify the key mathematical features and conditions, strategies and procedures that may be relevant in the generation of a solution**
- ✓ **Pose and refine questions to confirm or alter thinking and develop hypotheses and predictions**
- ✓ **Plan and conduct activities and investigations, using valid strategies and procedures to solve problems**
- ✓ **Select and use mental and written computations, estimations, representations and technologies to generate solutions and to check for reasonableness of the solution**
- ✓ **Use mathematical interpretations and conclusions to generalise reasoning and make inferences**
- ✓ **Evaluate their own thinking and reasoning, considering their application of mathematical ideas, the efficiency of their procedures and opportunities to transfer results into new learning**
- ✓ **Communicate thinking, and justify and evaluate reasoning and generalisations, using mathematical language, representations and technologies**
- ✓ **Reflect and identify the contribution of mathematics to their own and other people's lives**
- ✓ **Reflect on learning, apply new understandings and justify future applications.**

Appendix 2B: Clever Connectives (Literacy Consultant, Pat Hipwell, Logon Literacy Tips)

Words to help you with: Comparing, Cause and Effect, Contrasting, Sequencing, Generalisation, Qualifying, Emphasising, Illustrating, Adding

Linking words for Comparing, Cause and Effect, Contrasting, Sequencing, Generalisation, Qualifying

Appendix 3: Framework Linking Dirty Mathematics to the Senior Mathematics Subjects.

		THEMES			
YEAR LEVEL		***Planning***	***Designing***	***Investigating***	***Evaluating the use of mathematics in***
8	**EXAMPLES**	A holiday within Australia	A courtyard	What is the effect of a rainforest canopy on the transmittance of sunlight?	Anthropometry
9		An event	Unusual Houses**	What is good water?	Anthropometry and Forensic Science##
10		An overseas trip	A container	What is the best mulch?**	In senior school mathematics options
11 Mathematics A	**EXAMPLES**		Designing a rainwater tank for a house in Sandgate	The dating of archaeological findings**	
11 Mathematics B		A computer virus simulation;		The relationship between neck measurement and shirt size.	
11 Mathematics C		Matrix Codes		Koch Snowflakes	
11 Pre-vocational Mathematics		Planning a local and interstate itinerary			In developing and operating a small business
12 Mathematics A		A navigation exercise			Investing in the Stock market
12 Mathematics B			Designing optimized containers;		The charging and discharging capacitors
12 Mathematics C			Designing a parachute**		Markov Chains applied to Monopoly
12 Pre-vocational Mathematics			And developing a herb garden	The Australian Stock Exchange	

**** Samples of tasks provided below in Appendix 4**

Theme task, investigations, practical work provided in Appendix 5 to give a 'flavour' of the approach in each theme.

Appendix 4: Tasks samples

<table>
<tr>
<td>Middle School Example</td>
<td>
<u>Unusual Houses (Zorro's Secret</u> - The missing Walt Disney Episode<u>)</u>
(<u>http://www.williamlthomas.com/stories/discovery.htm</u>)
"…That night Diego and Alejandro went to bed. Bernardo decided to pack one of Zorro's costumes just in case they needed the Fox. He entered the secret passage through the front room cabinet. He packed Zorro's clothes and proceeded back down to where he entered. So preoccupied was Bernardo with the details of packing he failed to notice the secret panel still ajar….)

Your task is to design and construct an unusual house. Why is it unusual?

Like Zorro's hacienda, your house is to have secret passages for escape in times of trouble and/or the house should have secret meeting rooms with concealed entrances.

In you constructed model these should be well concealed and not easily identifiable.
</td>
<td>
<u>What is the best mulch – Gravel, Bark Chip or Sugar cane mulch?</u>

Develop an experimental strategy to answer the question.

Clearly define your control for reference.

Conduct your research, gathering data which you believe will be needed to justify your conclusions.

Present your findings in a form appropriate to your nominated audience.
</td>
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<tr>
<td>Senior School Example</td>
<td>
<u>Designing a parachute:</u>

TASK A – <u>Modelling the effect of surface area, mass.</u>
(a) Measure and record the time taken for a sheet of poster board to drop a certain distance. Repeat the drop at least 5 times with poster board of different dimensions but of the same mass. Record surface area against time. Display your data in tabular form. Clearly identify any constants and/or variables that you believe need to be taken into account.
(b) Develop a model appropriate to the data stating any assumptions that you may have made.
(c) Discuss the strengths and limitations of your model and the effects of any assumptions that you may have made.
TASK B – <u>Edward the Sky Diving Egg</u>
Synthesise a strategy to design a parachute system that will land a raw egg safely (unbroken) onto the bitumen from a height of 15m. Validate your design mathematically clearly indicating the effect of any assumptions made and yes, validate as well with a nice drop.
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<td>
<u>The Dating of Archaeological Findings</u>

Data has been collected on four different skull measurements from Egyptian males living in the area of the Great Pyramids from two different time periods: 4000BC and 150AD. The four skull measurements (mm) have been abbreviated as follows:

> MB: maximum breadth across the skull

> BH: basibregmatic height from base of the jaw to the top of the skull;

> BL: basialveolar length from the back of the skull to the front;

> NH: nasal height from the jaw to the base of the nose.

The data that is attached to this task is also available electronically from Q:\Students\Mathematics\11 Maths A\Skulls Data.xls for analysis.

"Have the dimensions of skulls altered significantly over the time period 4000BC to today?"
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Appendix 5: Theme 'Flavour' - Giving a fuller idea of what our students do: e.g. CSI Sandgate

TASK:

Your task is to determine who the missing person is, based on the finding of four complete bones found at an unused rubbish dump. Local police have compiled a list of 10 missing people who could be identified from these bones. Help the police build a case to identify the "owner" of the bones.

Samples of Theme investigations to aid development of analytical thought processes.

1. Numb3rs#

A gang of robbers taunted police by leaving a cryptic clue at the scene of each robbery. The latest clue read:

"The number of my house and those of two 'colleagues in crime' form three consecutive prime numbers whose product is equal to my telephone number. I live between my two colleagues and have a five digit telephone number whose first digit is 6. Catch me if you can"

Can you catch this criminal?

2. Pharoah's Pearls+

During an archaeological dig, a necklace of 23 pearls, strung together on a string, as shown was found. The necklace was around the neck of the mummified remains of a high priest along with a message which, when translated, read: "*To remove the curse for violating my everlasting rest, you must make 4 cuts in the string so that you can obtain any number of pearls from 1 to 23*". Where should you make the cuts to remove the curse?

Modified from *More Mathematical Activities, Brian Bolt, Cambridge University Press, 1985*

\+ **Modified Maths In-Service Project, 1990 Activity**

Sample Practical Work used to develop investigative skills, data analysis, inferential thought processes.

(e.g. CSIRO Double Helix Science by Email Activities – www.csiro.au/helix/sciencemail/activities/BloodSpatter.html)

Try this: Bloody Trigonometry

Forensic investigators often encounter crime scenes containing traces of blood. Aside from the information the blood itself can provide, the shapes and arrangement of the drops can tell investigators what happened at the scene. Trigonometry can be a useful tool in blood spatter analysis.

You will need to make the 'blood':

Chocolate sauce, Red food dye, Water, Measuring cup, Mixing bowl, Drinking straw, Old clothes, 5 large sheets of white paper (at least A3 size), Scientific calculator

Drops of this 'blood' will be dropped at different angles onto the paper.

As the drop strikes the surface from a steep angle, most of its volume will stick. Inertia carries the rest of the drop forward, often ending in a thin line or tail. Therefore the tail always points away from where the blood drop originated. The longer the tail, the lower the 'launch' angle

Investigators can then use trigonometry to calculate the angle of impact and trace this back to an approximate starting place. This provides evidence about the crime scene and the method of attack on the victim. The ratio of the drop's width to the drops length gives the sine of the angle.

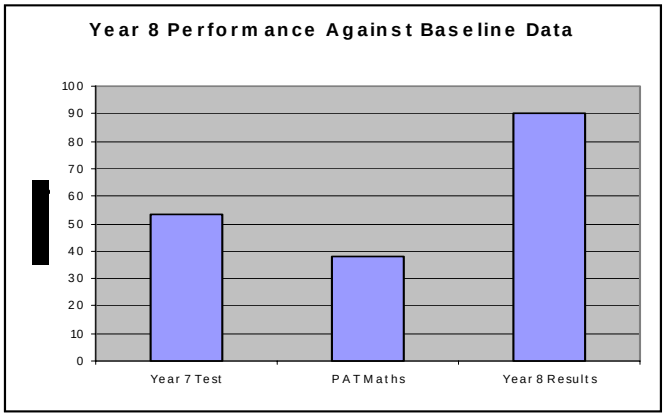
Experiment with various 'launch' angles to validate this relationship.

APPENDIX 6 - A detailed view of the Data

Comparative results – School Performance against available Baseline Data

2007 Cohort Overall

YR 7 Tests 2006 % C and above	PAT Maths 2007 % C and above	YR 8 2007 % C and above
53.5	38.1	90.3



NOTE: The higher performance of students engaged in Dirty Mathematics with 90.3% achieving a C grade or higher compared to baseline measures of 38.1% for PAT Maths and 53.5% on the Year 7 Test.

Students with learning difficulties - improved results:

T1 – needing minor changes to class work and the monitoring of performance, **T2** – needing significant assistance from classroom teacher and **T3 -** requiring modification of learning materials and assessment and support teacher assistance. NR not rated.

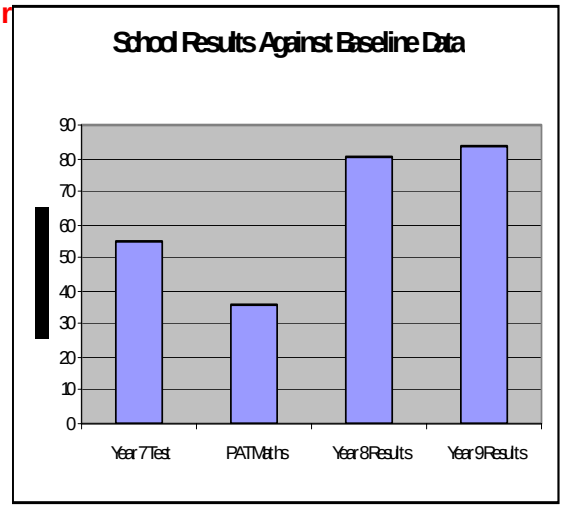
	REPORT GRADE					
LEVEL OF NEED	A	B	C	D	E	NR
T1	0%	44.4%	44.4%	0%	0%	11%
T2	0%	23.1%	46.2%	15.%4	5.3%	0%
T3	25.0%	12.5%	12.5%	37.5%	0.0%	12.5%

NOTE: The vast majority of these students have achieved above expectation with the relevant learning and assessment adjustments made - 88.8% T1 achieving a C grade or higher, 69.3% of T2 students achieving a C Grade or higher and 50% of T3 students achieving C or higher.

Identified ATSI Students:

Student	School Result	Year 7 Numeracy	PAT Maths	Comments
1	B	D	C	Performing above expectation
2	B	D	C	Performing above expectation
3	B	D	D	Performing above expectation
4	B	D	E	Performing above expectation
5	C	D	E	Performing on par or better
6	D	D	E	Performing on par
7	C	C	E	Performing on par or better
8	C	C	C	Performing below expectation
9	C	D	D	Performing above expectation

The vast majority of these students are performing above expectations. With the exception of Student 8, all students are achieving one or two grades higher than the baseline data grades.



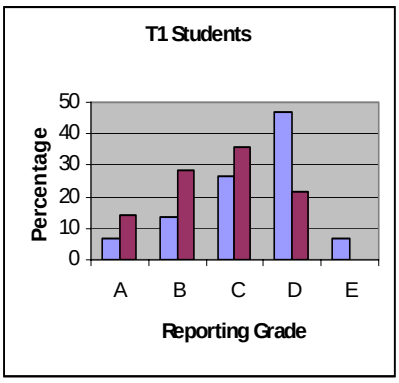
2006 Cohort Overall

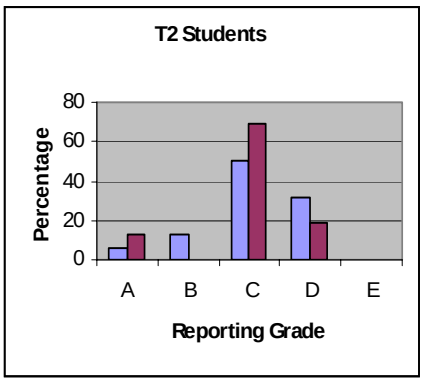
YR 7 Test 2005 % C and above	PAT Maths 2006 % C and above	YR 8 2006 % C and above	YR 9 2007 % C and above
54.7	35.9	80.4	83.7

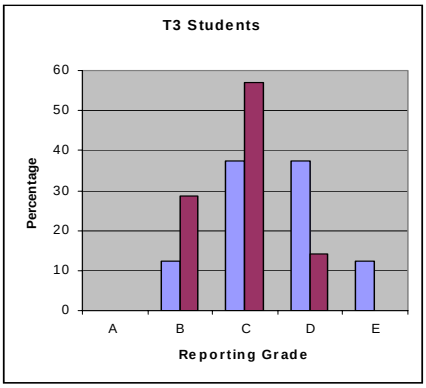
NOTE: The higher and improving performance of students (80.4% to 83.7%) engaged in Dirty Mathematics compared to 54.7% on the Year 7 Test and 35.9% on the PAT Maths results.

Students with learning difficulties – improved performance of Year 8 students and continued improvement through to Year 9.

The majority of students continue to achieve above expectation, with the relevant learning and assessment adjustments made, and have a significant improvement in performance from Year 8 to Year 9







Success does indeed breed success giving continued improvement. With the success of Dirty Mathematics, students have improved significantly on their baseline data.

ATSI Students – improved results in Year 8 and into Year 9

Student	School Result Yr 9	School Result Yr 8	Year 7 Numeracy	PAT Maths	Comments
1	D	E	D	D	Continues to be performing on par
2	A	C	D	E	Continues to be Performing above expectation
3	LEFT	D	----	----	Was none at that stage
4	D	D	C	D	Continues to be Performing on par
5	LEFT	D	C	E	Was performing above expectation
6	LEFT	C	E	----	Was performing above expectation
7	D	D	D	E	Continues to be performing above expectation
8	LEFT	C	----	E	Was performing above expectation
9	D	D	E	E	Continues to be performing above expectation

NOTE: The vast majority of these students are performing above expectations with improvement in performance. With the students remaining at Sandgate Student 1 improved from an E to a D and Student 2 improved from a C to an A. The remaining students' performance was similar to that in Year 8 continuing to be above expectations from the baseline data measures.

Greatly Improved Performance of Student Identified as 'Under the National Benchmarks'

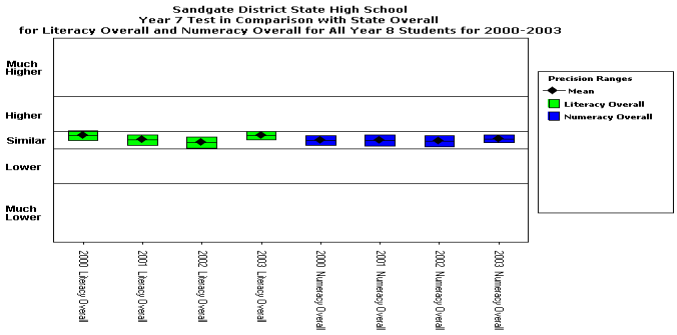
	PERCENTAGE REPORTING GRADE				
YEAR 8 in …	A	B	C	D	E
2007 (n = 39)	2.6	20.5	56.4	17.9	2.6
2006 (n = 29)	0	10.3	55.2	27.6	6.9

NOTE: The results of the Year 7 Tests for each of these two cohorts indicate that each of these students was graded at an E level. After 1 year and 2 years respectively of Dirty Mathematics, students are performing at a significantly higher level. The 2007 Year 8 cohort had 79.5% achieving a C grade or better, while the 2006 Year 8/2007 Year 9 cohort had 65.5% achieve a C grade or better.

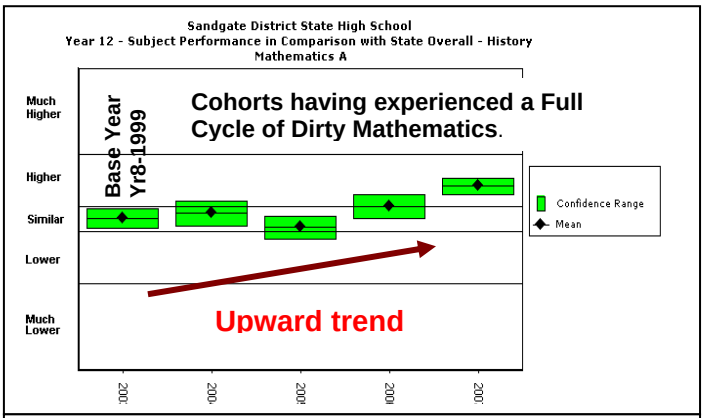
APPENDIX 7: The Groundwork for Success – Long Term Improved Performance

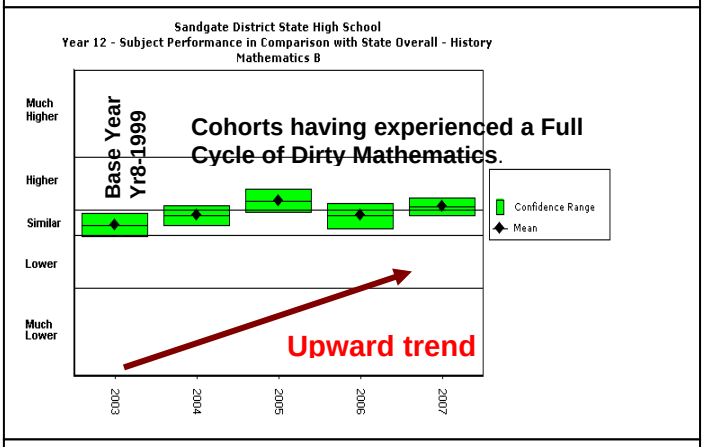
BASELINE MEASURE: Year 7 Numeracy Historical Data for Year 8 Cohorts 2000-2003

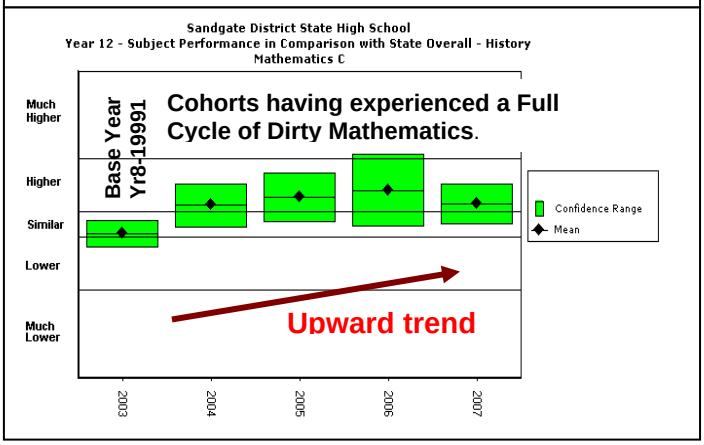
The graph on the right shows that each Year 8 cohort entered Dirty Mathematics performing being *Similar to Like School's across the State* in Numeracy.



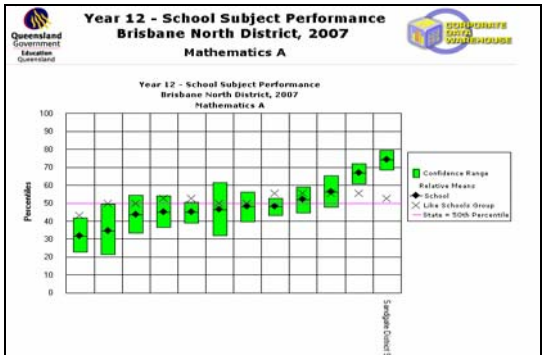
The graphs below shows the improvement in performance compared against the **State** Exit performances for each of the three Senior Mathematics subjects. **Each cohort of students in each subject performed higher than like schools across the State.**

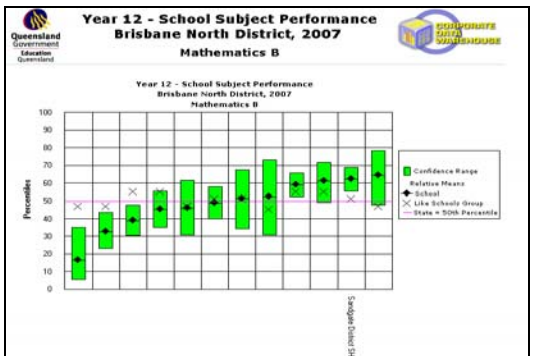


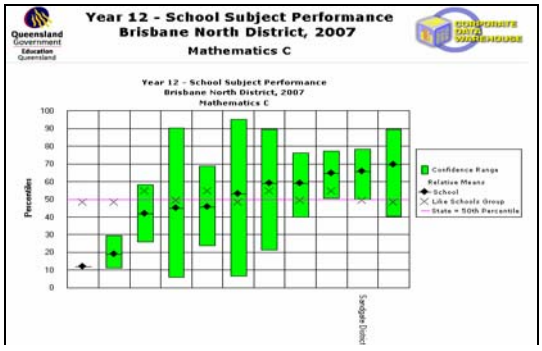




The following graphs show that in 2007, our **Mathematics A** cohort performance was the **best in the district** and for **Mathematics B and Mathematics C,** our performance placed both groups of students as the **second** top school respectively in the District.







DIRTY MATHEMATICS PROVIDES STUDENTS WITH SHORT TERM AND LONG TERM SUCCESS AND GIVES OUR STUDENTS MORE POST-COMPULSORY SCHOOLING OPTIONS

Sandgate District State High School

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P.O. Box 195, Sandgate. 4017

Phone: 3869 9888
FAX: 3869 9800

Email: the.principal@sanddistshs.eq.edu.au

Website: www.sanddistshs.eq.edu.au

Expanding Horizons...

Endorsements

PRINCIPAL

19 March 2008

RE: Sandgate District State High School Showcase Submission "Dirty Mathematics"

The "Dirty Mathematics" initiative is worthy of consideration for a Showcase Excellence in Middle Schooling Award for the following reasons:

- It is the culmination of 8 years work by the Mathematics Department to develop and refine a problem solving curriculum to facilitate the development of mathematical skills in students
- The program successfully engages students and there is clear evidence of significant value adding to the level of Mathematical skills of students throughout the Middle School and into the Senior School. In the Senior School, in terms of levels of achievement, Sandgate has the best outcome data for Maths A and B in the district, despite the low level of Mathematical performance evident on entry to the school
- Mathematics teachers have undertaken significant professional development in literacy, Brain Based Learning and ICT and have been able to apply their learning in the classroom. The program is sustainable because there is a high level of ownership and commitment to program delivery by all staff. The quality of teaching is outstanding across the faculty.
- The program addresses a number of EQ priorities, as indicated in the submission and is transferrable to other locations.

Yours sincerely

Jeanette Gentle
(Principal)

PARENTS - THROUGH THE PARENTS & CITIZENS ASSOCIATION

19 March 2008

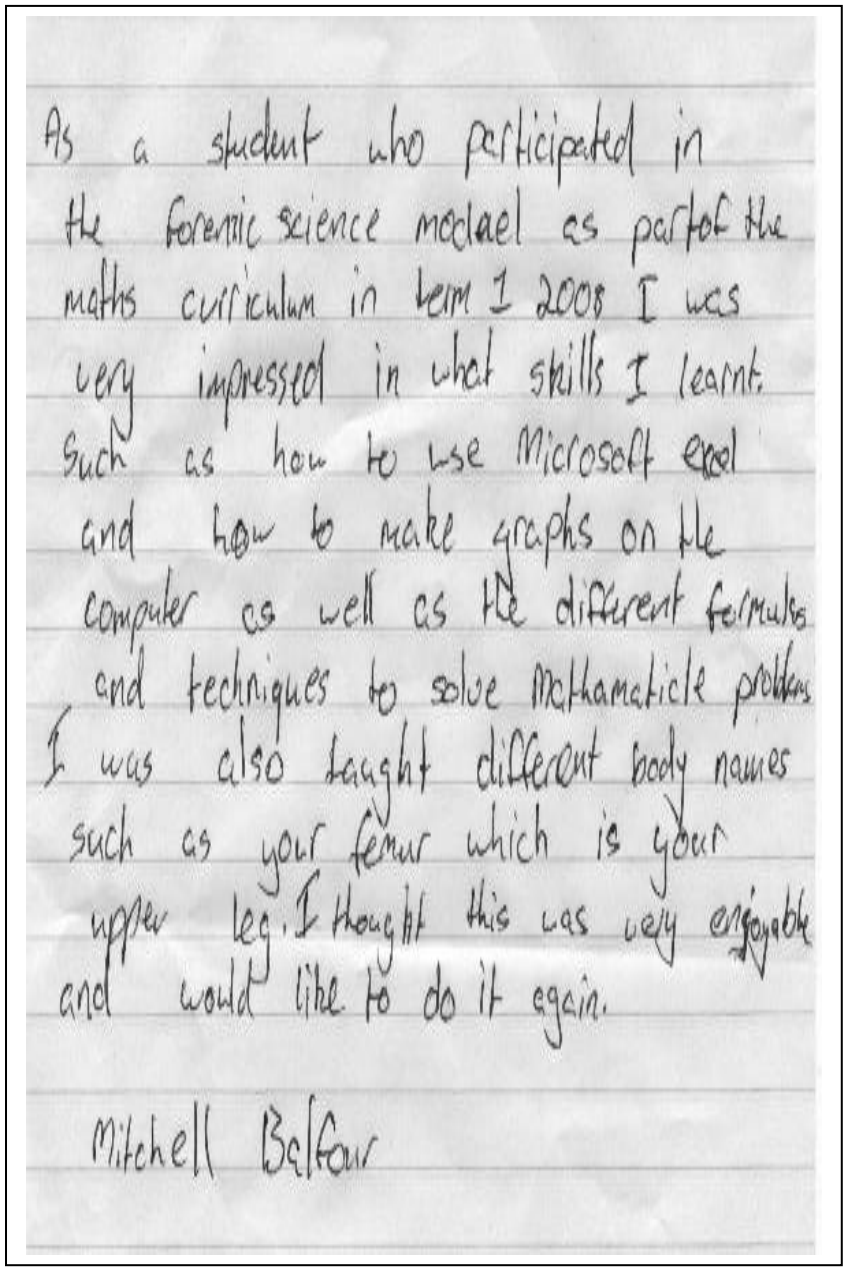
RE: Sandgate District State High School Showcase Submission "Dirty Mathematics"

The P&C of Sandgate District State High school support the school's Showcase submission "Dirty Mathematics". For the past 8 years the Mathematics Department has worked to implement a problem solving curriculum. Students enjoy this practical approach to the teaching of Mathematics. The title "Dirty Mathematics" and the chance to literally get their hands dirty has had great appeal to our middle schooling students. Engagement of students in learning is high and as a consequence, the results of the Mathematics are outstanding. Mathematics teachers at Sandgate are highly regarded by students as students enjoy the activities that are put in place to help them learn. The Mathematics Department at Sandgate District State High school should be commended on making Mathematics fun and assisting students to get excellent results.

Yours Sincerely

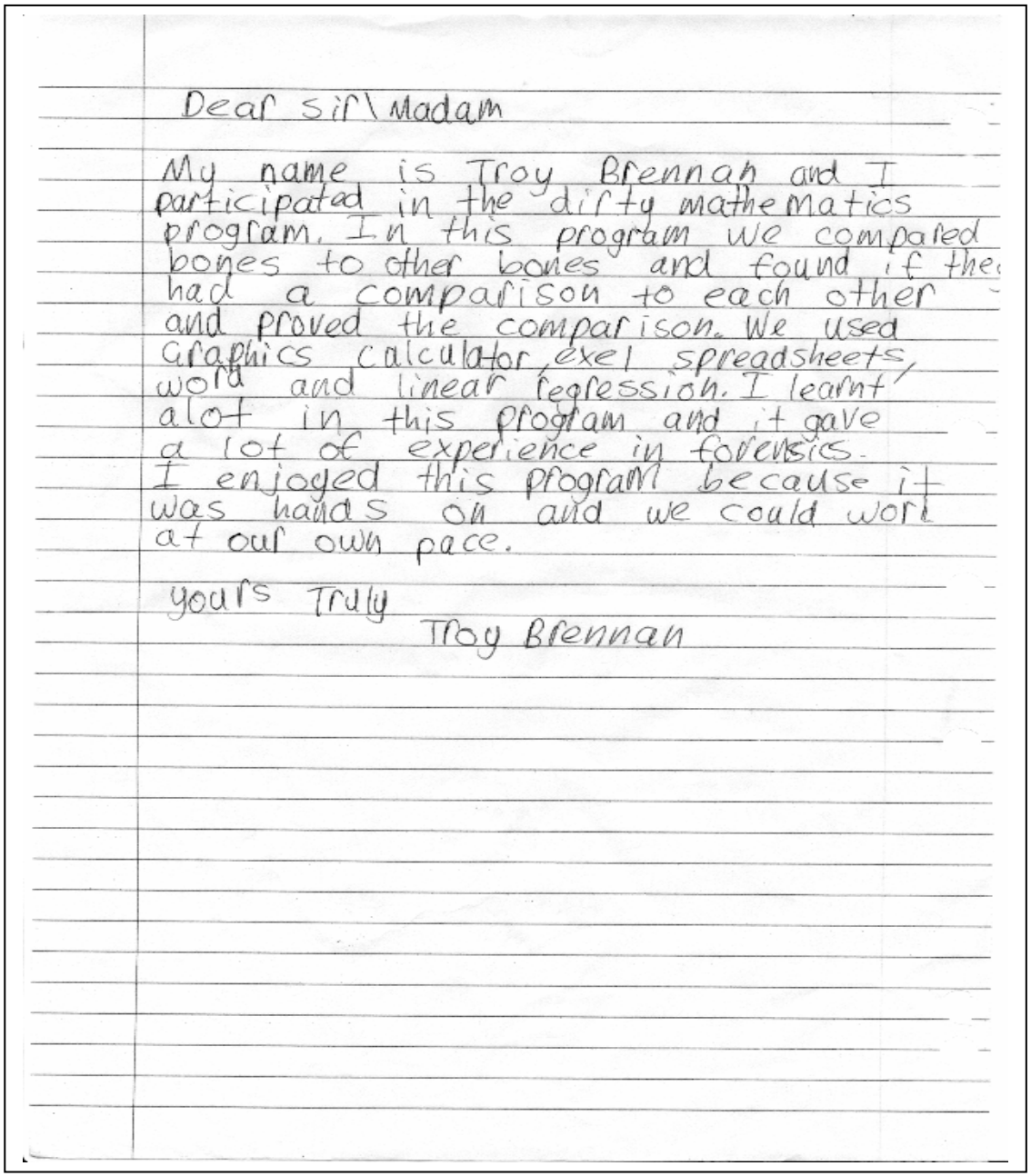
Lyn Skinner
(P&C President)

STUDENTS



As a student who participated in the forensic science modael as part of the maths curriculum in term 1 2008 I was very impressed in what skills I learnt. Such as how to use Microsoft excel and how to make graphs on the computer as well as the different formulas and techniques to solve mathamaticle problems I was also taught different body names such as your femur which is your upper leg. I thought this was very enjoyable and would like to do it again.

Mitchell Belfour



Dear sir\Madam

My name is Troy Brennan and I participated in the dirty mathematics program. In this program we compared bones to other bones and found if the had a comparison to each other and proved the comparison. We used Graphics calculator, exel spreadsheets, word and linear regression. I learnt alot in this program and it gave a lot of experience in forensics. I enjoyed this program because it was hands on and we could work at our own pace.

yours Truly

Troy Brennan