Measurement Activities
Booklet MA: Using Measurement to Teach Numeration and Operations

ASISTM Cherbourg-Woorabinda Project:
Using Finance and Measurement Applications to Improve Number Understandings for Indigenous Students

MEASUREMENT ACTIVITIES BOOKLET

USING MEASUREMENT TO TEACH NUMERATION AND OPERATIONS

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YuMi Deadly Maths
Past Project Resource
Acknowledgement

We acknowledge the traditional owners and custodians of the lands in which the mathematics ideas for this resource were developed, refined and presented in professional development sessions.

YuMi Deadly Centre

The YuMi Deadly Centre is a Research Centre within the Faculty of Education at Queensland University of Technology which aims to improve the mathematics learning, employment and life chances of Aboriginal and Torres Strait Islander and low socio-economic status students at early childhood, primary and secondary levels, in vocational education and training courses, and through a focus on community within schools and neighbourhoods. It grew out of a group that, at the time of this booklet, was called “Deadly Maths”.

“YuMi” is a Torres Strait Islander word meaning “you and me” but is used here with permission from the Torres Strait Islanders’ Regional Education Council to mean working together as a community for the betterment of education for all. “Deadly” is an Aboriginal word used widely across Australia to mean smart in terms of being the best one can be in learning and life.

YuMi Deadly Centre’s motif was developed by Blacklines to depict learning, empowerment, and growth within country/community. The three key elements are the individual (represented by the inner seed), the community (represented by the leaf), and the journey/pathway of learning (represented by the curved line which winds around and up through the leaf). As such, the motif illustrates the YuMi Deadly Centre’s vision: Growing community through education.

More information about the YuMi Deadly Centre can be found at http://ydc.qut.edu.au and staff can be contacted at ydc@qut.edu.au.

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ASISTM Cherbourg-Woorabinda Project:  
Using Finance and Measurement Applications to Improve Number Understandings for Indigenous Students

DEADLY MATHS PROJECT

Measurement Activities Booklet

USING MEASUREMENT TO TEACH NUMERATION AND OPERATIONS  
16/09/2007

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BACKGROUND

The focus of this booklet was to use Measurement to reinforce number and operations. The aims of the materials were to teach the following:

(1) **Number and numeration**: (1) *Counting and odometer* – every place value counts up to 9 and then back to 0 as the left place value increases by 1, and back to 0 and then up to 9 as the left place value decreases by 1; (2) *Place value* (separation) – numbers are written and said in terms of digits in place value positions (e.g., 384 is 3 hundred and eighty four); (3) *Rank* – no matter what the digits, each number is one position on the numberline and is in order in relation to all other numbers (e.g., 384 and 358 are both between 300 and 400 and 384 > 358); and (4) *Multiplicative structure* – moving place-value positions to the left is ×10 and to the right is ÷10.

(2) **Operations**: (1) *Addition* – adding two and three-digit numbers by sequencing (e.g., 47+26=47+20+6=67+6=73); (2) *Subtraction* – subtracting two and three-digit numbers by sequencing (e.g., 62-27=62-20-7=42-7=35, and 27+3+30+2=62, so difference is 3+30+2=35); (3) *Multiplication* – multiplying 3-digits by 1 digit by arrays (e.g., (342×2=600+80+4=684); and (4) *Division* – dividing 3 digits by 1 digit by inverting the arrays (e.g., 684÷2=300 twos, 40 twos, 2 twos).

The basis of the teaching activities are the following:

(1) **Payne-Rathmell triangle** – start with real world situations, go to models (materials, computers, pictures) then language and finally symbols then interrelate all these parts.

(2) **Kinaesthetic activity** – start where possible with whole body activity, go to material and picture models, and finish at imagining (pictures in the mind).

(3) **Generic pedagogies** – at all times reverse (go both ways – e.g., move left is it × or ÷ 10, x 10 is it left or right move), try for generalisations (e.g., 4×70=(4×7)0), and be flexible (e.g., two methods for subtracting).

The materials developed to support these aims in the ASISTM project are this booklet plus a booklet on teaching measurement and a CD on virtual materials. The activities in this booklet owe much to the people in the Deadly Maths Group. In particular:

(1) the method used in Section 1 Unit 2 was developed by Annette Baturo as were the ideas for the virtual mathematics materials that are provided with this booklet; and

(2) the typing and drawings add much to the booklet and are the result of great effort by Fiona Hobbs, Charlotte Cottier and Tiara Cassady.
SECTION 1: USING LENGTH MEASUREMENT TO TEACH NUMERATION

Unit 1: Counting and Rank

This unit will use metre rule, measuring tapes (mm, cm, m) and other constructed “tapes” to: (1) facilitate the counting pattern for numbers up to 1000; (2) reinforce odometer patterns in counting through 9 ones and 9 tens/9 ones and counting back through 0 ones and 0 tens/0 ones; (3) build understanding of “rank” (comparison and order) for numbers up to 1000; and (4) introduce mm, cm and m.

Activity 1
Activity 2
Activity 3
Activity 4
Activity 5

Unit 2: Place Value and Multiplicative Structure

This unit will consider metric conversions of length (mm, cm, m and km) to: (1) reinforce place value positions; (2) facilitate understanding of the multiplicative relationship between adjacent place-value positions; and (3) introduce the conversion rates between mm, cm, m and km.

Activity 1
Activity 2
Activity 3
Activity 4
Activity 5
Unit 1: Counting and Rank

Using cm/m and mm/m to look at counting and rank 1-100 and 1-1000.

ACTIVITY 1

Objectives
Introduce students to Metre (m)
Introduce ranking of numbers from 1 to 100.

Materials
Straws (2 colours), string, scissors, sticky tape, paper or card, measuring tape or metre ruler.

Directions
Cut 10cm lengths of straws (5 of each colour).
String straws alternately on string to make a “straw tape”:

Compare final length with m – how accurate is it?

Use the “straw tape” to find 3 things on body and 3 things in classroom that are close to 1m.
Choose objects that you have to measure vertically as well as horizontally.

(1) Label the end of each straw as follows.

Find where the following would be on the “straw tape”:

30, 80, 28, 64.

State the numbers that are where the teacher is pointing. (Teachers point to positions on one of the “straw tapes”.)

(2) Use the “straw tape” to work out the larger (smaller) of the following:

26 or 46  42 or 39  68 or 64  48 or 51

Place the following in order from largest to smallest:

54, 61, 16, 59, 65

(3) Complete a worksheet that will practice the ideas in the above material.
ACTIVITY 2

Objectives

(1) Introduce students to centimetre (cm) and metre (m) and the relationship between them.

(2) Count 1 to 100 and introduce odometer principle for counting on past 9 ones and counting back past 0 ones.

(3) Consolidate ranking of numbers 1 to 100.

Materials

1 cm graph paper, scissors, measuring tape or metre ruler, sticky tape.

Directions

(1) Cut strips of graph paper 10cm long, join 10 strips with sticky tape to make a “graph paper tape”.
Label joins 10, 20, 30, 40 ... 90, and label the start 0 and the end 100.

Use the “graph paper tape” to count from 55 to 62, then from 87 to 94.
What happens when go past 9 ones? Can you write this as a rule?

Use the “graph paper tape” to count back from 63 to 54, then from 36 to 28.
What happens when go back past 0 ones? Can you write this as a rule?

(2) Use the “graph paper tape” to measure:

- hand span
- cubit
- length of foot
- length of lower leg
- width of door
- length of desk
- height of board
- distance around fist
- distance around head

(3) Find the following on “graph paper tape”:

19  63  48  72  85  61

State the numbers that are where the teacher is pointing. (Teacher points to various positions on one of the “graph paper tapes”.)
(4) Use “graph paper tape” to see which of the following is larger:

63 or 72  41 or 38  64 or 69  81 or 77

(5) Do the following activities/games:

- “Make a train” and “bigger train”
- “Go fish”

**“Make a train”**

Materials: 10 cm and 1 cm lengths (MAB, straws, cm graph paper), tape, ruler, string, scissors.

Directions:
(1) Place material in a bag. Reach in, grab a handful of materials. Place end on end (put on string if straws), state how long it is.
(2) Throw a die twice, first throw 10 cm lengths, second throw 1 cm lengths, winner is who makes longest/shortest length.
(3) Throw a die twice, chose one number for 10 cm lengths and the other number for 1 cm lengths, the winner is who makes longest/shortest length.
(4) Throw a die, choose whether this will be 1 cm or 10 cm lengths, throw the die again and this number is what was not chosen, winner is who makes longest/shortest length.

**“Go fish”**

Materials: Fish shapes of various length, paper clips, stick, string, magnet

Directions:
(1) String magnet onto stick, put paper clips on noses of fish. Go fishing, with magnet, measure the fish caught with “graph paper tape”. Winner catches the longest/shortest fish.
(2) Same as above but throw back if below a certain length.
(3) Reverse – students construct fish of stated lengths.

Complete a worksheet that will practice the ideas in the above material.
ACTIVITY 3

Objectives

(1) Reinforce rank numbers 1 to 100.

(2) Reinforce that 10s are most important in rank for numbers 1 to 100.

Materials

Digit cards, “chance number” and “chance order” game boards, card deck with 0, 1, 2 ..., 9 cards (if ordinary deck use Ace for 1 and 10 for 0).

Directions

(1) Cut out digit cards.

(2) Play “Chance number” games:

<table>
<thead>
<tr>
<th>“Chance number” – “Make a number”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials: digit cards, “Chance number” board, card deck (0-9 only)</td>
</tr>
<tr>
<td>Directions:</td>
</tr>
<tr>
<td>(1) After teacher (or another student) deals 2 cards, use numbers to make smaller/larger number with digit cards on game board as required.</td>
</tr>
<tr>
<td>(2) As teacher (or another student) deals 2 cards one at a time, use first number to place a digit card on board (have to choose tens or ones), second number fills the other position. If make higher/lower number, score 1 point, 0 otherwise. Winner is largest score after 5 games.</td>
</tr>
<tr>
<td>(3) As for (1) or (2) above but win if closest to 50.</td>
</tr>
<tr>
<td>(4) As for (1) above, but three cards are dealt to choose from.</td>
</tr>
</tbody>
</table>

“Chance number” – “Beat the teacher”

Materials: digit cards, “Chance number” board, card deck (0-9 only)

Directions:

(1) As for “Make a number” but score/win if beat the teacher (who is also playing).

“Chance number” – “Risk a card”

Materials: digit cards, “Chance number” board, card deck (0-9 only)

Directions:

(1) As for “Make a number” (2) but when complete, can give up a number and take the value of a third dealt card.

(2) “Double risk” – can give up two numbers and 4 cards dealt (one at a time) – can set rule that numbers cannot be risked from the same place value.
(3) Play “chance order” games

"Chance number"

Materials: digit cards, “Chance order” board (greater than or less than version), card deck (0-9 only)

Directions:

(1) After teacher (or another student) deals 4 cards, use numbers to make the left hand 2-digit number smaller/larger than the right hand number with digit cards on game board as required. Score 1 point if left hand 2-digit number is correctly larger (smaller) than right hand 2-digit number. Score 2 points if smaller 2-digit number is largest possible. The winner is who has highest score after 5 games.

(2) As teacher (or another student) deals 4 cards one at a time, use first number to place a digit card on board (have to choose tens or ones in either the left hand or right hand 2-digit number), continue making choices and placing digits on board before next card called. Score 1 if correct and 0 if not. The winner is who has highest score after 5 games.

(3) As teacher (or another student) deals 4 cards one at a time, use first number to place a digit card on board (have to choose tens or ones in either the left hand or right hand number), continue making choices and placing digits on board before next card called. Score 0 if not correct but score the value in the tens place of the smaller 2-digit number if correct. The winner is who has highest score after 5 games.
ACTIVITY 3 – DIGIT CARDS

6
3
9
5
2
8
4
1
7
3
9
6
2
8
5
1
7
4
ACTIVITY 3 – “CHANCE NUMBER” BOARDS

Board 1

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Board 2

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ACTIVITY 3 – “CHANCE ORDER” BOARD (LESS THAN)
ACTIVITY 3 – “CHANCE ORDER” BOARD (GREATER THAN)

Ones

Tens

greater than

Ones

Tens
ACTIVITY 4

Objectives
(1) Introduce millimetre (mm) and relation of mm to cm and to m.
(2) Introduce counting 1 to 1000.
(3) Introduce odometer for counting past 9 tens/9 ones and for counting back past 0 tens/0 ones.
(4) Introduce ranking numbers 1 to 1000.

Materials
Metre ruler or measuring tape.

Directions
(1) Place out ruler or tape showing mm from 1 to 1000 or 1m.
(2) Measure 2 things on body and in classroom that are 1mm and 5mm.
   Count how many mm in 1cm.
   Look at how many mm in 1m.
(3) Measure the following in mm:
   finger length, distance around neck, length of arm,
   height of desk, width of window, length of whiteboard.
(4) Count on the ruler:
   97 to 104  392 to 401  795 to 802
   What happen when count past 9 tens/9 ones? Write a rule.
   203 to 198  604 to 597  905 to 898
   What happens when count back past 0 tens/0 tens? Write a rule.
(5) Find the following numbers:
   27  256  901  387  620  417
   State the number where the teacher is pointing.
(6) Use ruler/tape to find the larger (smaller) number:
   368 or 421  647 or 652  814 or 784  604 or 540
(7) Complete a worksheet that will practice the ideas in the above material
ACTIVITY 5

Objectives
(1) Reinforce rank numbers 1 to 1000.
(2) Reinforce that 100s and then 10s are important places in rank.
(3) Extend rank to numbers 1 to 10,000.

Materials
Digit cards (see Activity 3), new 3-digit “chance number” and “chance order” game boards, card deck (2–9, A–1, 10–0).

Directions
(1) Obtain digit cards and game boards.
(2) Play 3-digit “Chance number” games.

<table>
<thead>
<tr>
<th>3-digit “Chance number” – “Make a number”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials: digit cards, 3-digit “Chance number” board, card deck (0-9 only)</td>
</tr>
<tr>
<td>Directions:</td>
</tr>
<tr>
<td>(1) After teacher (or another student) deals 3 cards, use numbers to make smaller/larger number with digit cards on game board as required.</td>
</tr>
<tr>
<td>(2) As teacher (or another student) deals 3 cards one at a time, use first number to place a digit card on board (have to choose tens or ones), second number fills the other position. If make higher/lower number, score 1 point, 0 otherwise. Winner is largest score after 5 games.</td>
</tr>
<tr>
<td>(3) As for (1) or (2) above but win if closest to 500.</td>
</tr>
<tr>
<td>(4) As for (1) above, but four cards are dealt to choose from.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3-digit “Chance number” – “Beat the teacher”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials: digit cards, 3-digit “Chance number” board, card deck (0-9 only)</td>
</tr>
<tr>
<td>Directions:</td>
</tr>
<tr>
<td>(1) As for 3-digit “Make a number” but score/win if beat the teacher (who is also playing).</td>
</tr>
</tbody>
</table>

“Chance number” – “Risk a card”

Materials: digit cards, 3-digit “Chance number” board, card deck (0-9 only)

Directions:
(1) As for 3-digit “Make a number” (2) but when complete, can give up a number and take the value of a fourth dealt card.
(2) “Triple risk” – can give up three numbers and 6 cards dealt (one at a time) – can set rule that numbers cannot be risked from the same place value.
(3) Play 3-digit “Chance order” games

### 3-digit “Chance number”

**Materials:** digit cards, 3-digit “Chance order” board (greater than or less than version), card deck (0-9 only)

**Directions:**

1. After teacher (or another student) deals 6 cards, use numbers to make the left hand 3-digit number smaller/larger than the right hand number with digit cards on game board as required. Score 1 point if left hand 3-digit number is correctly larger (smaller) than right hand 3-digit number. Score 2 points if smaller 3-digit number is largest possible. The winner is who has highest score after 5 games.

2. As teacher (or another student) deals 6 cards one at a time, use first number to place a digit card on board (have to choose tens or ones in either the left hand or right hand 3-digit number), continue making choices and placing digits on board before next card called. Score 1 if correct and 0 if not. The winner is who has highest score after 5 games.

3. As teacher (or another student) deals 6 cards one at a time, use first number to place a digit card on board (have to choose tens or ones in either the left hand or right hand number), continue making choices and placing digits on board before next card called. Score 0 if not correct but score the value in the tens place of the smaller 3-digit number if correct. The winner is who has highest score after 5 games.

(4) Play the following extensions of the games

- 4-digit versions of “Chance number”.
- Triple 2-digit versions of “Chance order” (2-digit less than/greater than-digit less than/greater than 2-digit).

**Note:** In the “Chance order” board games, a box has been given between the numbers – this can be filled with less than (<) or greater than (>).
**ACTIVITY 5 – 3-DIGIT “CHANCE NUMBER”**

**Board 1**

<table>
<thead>
<tr>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Board 2**

<table>
<thead>
<tr>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ACTIVITY 5 - 4-DIGIT "CHANCE NUMBER"

**Player 1**

<table>
<thead>
<tr>
<th>Thousands</th>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Player 2**

<table>
<thead>
<tr>
<th>Thousands</th>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ACTIVITY 5 – 3-DIGIT “CHANCE ORDER”

<table>
<thead>
<tr>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Ones

<table>
<thead>
<tr>
<th>Tens</th>
<th>Hundreds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Tens

<table>
<thead>
<tr>
<th>Hundreds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>
ACTIVITY 5 – TRIPLE 2-DIGIT “CHANCE ORDER”

Ones

Tens

Ones

Tens

Ones

Tens
Unit 2: Place Value and Multiplicative Structure

Applying notions of place value from ones to millions to cm/m and mm/m/km to see how relations in metrics can help reinforce place value understandings.

ACTIVITY 1

Objectives
(1) Reinforce place value for 100s, 10s and 1s.
(2) Introduce relationships between positions in 100s, 10s and 1s.

Materials
A5 sheets, calculators.

Directions
(1) Make up the following A5 sheets
Place Value (PV) cards:

Digit Cards:

<table>
<thead>
<tr>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Give 3 students PV cards and organise them to stand in correct position:

(2) Give another student a digit card, say 6, and get them to stand in front of each position. Add zero cards to show what each number means. Press buttons to place numbers on calculator, e.g.:

<table>
<thead>
<tr>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calculator</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
</tr>
</tbody>
</table>
Repeat this for 2 and 3 digit numbers on cards in front of PV cards,
e.g. 230, 604, 14, 824, 615.
Move from cards to calculator and calculator to cards.
Say numbers in terms of 100s, 10s and 1s and properly.

(3) Put a digit card in front of PV cards, move card left and right, use calculator x and ÷ buttons to show relationship in moves.

\[ \text{e.g.} \quad 6 \text{ tens} \rightarrow 6 \text{ ones} \text{ is } \div 10 \]
\[ 6 \text{ ones} \rightarrow 6 \text{ hundreds} \text{ is } \times 100 \]
Put a number in calculator, e.g. 40 and multiply or divide by 10, move cards to show these multiplications and divisions:

\[ \text{e.g.} \quad \times 10 \]
\[ \div 10 \]

Write down patterns in movements and relation to x and ÷ 10.

(4) Play game “Wipeout”:

**“Wipeout”**

Materials: Calculator, worksheet (if wanted).

Directions:

(1) One student calls out 3 digit number, e.g. 673. Other students put in calculator then 1
\text{st} student calls out a digit. Other students have to change number on calculator to 603 (wipe the 7) with a single subtraction (e.g. \(-70\)).

(2) Can be used as a worksheet as below:

<table>
<thead>
<tr>
<th>Number</th>
<th>Digit</th>
<th>Subtraction</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>284</td>
<td>8</td>
<td>(-80)</td>
<td>204</td>
</tr>
</tbody>
</table>
ACTIVITY 2

Objectives
(1) Relating cm to mm to 10s and 1s.
(2) Reinforcing relation of cm and mm.
(3) Introducing metric conversion cm/mm.
(4) Introducing tenths.

Materials
Metre rulers/tapes, digit and place value (PV) cards, A5 paper, calculator.

Directions
(1) Put out PV cards.
   Make up new cards.
   Look at relation cm/mm on metre rulers and tapes.
     - How many mms in a cm? (ten)
     - What fraction of a cm is a mm? (one tenth)

(2) Replace ones with mm, tens with cm, and hundreds with 10 cm. Discuss why this can be done. Discuss how many mm in cm, mm in 10cm and so on. Put digit cards in front of PV cards.
   E.g.

   Use zero cards to determine answer in mm (e.g., 604) or cm and mm (e.g. 60cm, 4mm).
(3) Give students a digit card to move in front of PV cards, e.g. 3

Use a calculator to relate $\times$, $\div$ to movement left and right. Ensure operate in both directions: given $\times \div \rightarrow$ find $\leftarrow$; given $\leftarrow$ find $\times$, $\div$.

(4) Consider the cm are now ones. Discuss how this changes PV. Relate to tens, ones and tenths. Bring in decimal point.

Put digit 9 in front and move it around. Add in more digits. Use 0 digit. Relate to old situation:

Discuss how cm relate to mm. Suggest a rule for converting cm to mm and mm to cm.

(5) Construct a cm/m slide rule. Use slide rule to show how numbers/measures change when cm or mm is the one. Go from number $\rightarrow$ mm/cm and cm/m $\rightarrow$ number, e.g.:

$$
10\text{cm} \quad \text{cm} \quad \text{mm} \\
5 \quad 4 \quad 6 = 54.6\text{cm or 546mm}
$$

(6) Undertake worksheets converting mm to cm and cm to mm.
ACTIVITY 2 – MM ↔ CM SLIDE RULE

Instructions: Cut out slide and slides. Cut along dotted lines. Insert slides.
**ACTIVITY 3**

**Objectives**

1. Relating m and cm to 100s, 10s and 1s.
2. Reinforcing relation between m and cm.
3. Introducing metric conversions m/cm.
4. Reinforcing 2 decimal places (tenths and hundredths).

**Materials**

Metre rulers and tapes, digit and PV cards, A5 paper, calculator.

**Directions**

1. Put out 5 existing PV cards

   ![Diagram 1](image1)

   Make up new card

   ![Diagram 2](image2)

   Look at metre rulers/measuring tapes. How many cm in 1m? What fraction of 1m is a cm?

2. Replace ones with cm and hundreds with m (and, therefore, tens with 10 cm).

   ![Diagram 3](image3)

   Discuss why can be done? Discuss how many cm in 10cm? How many 10cm in m? How many cm in m? Relate back to replaced PV cards. Reverse activities. What is 10cm as a fraction of 1m? What is cm as a fraction of 1m?

   Give students a digit card – move card around. State how many m, how many cm.

   E.g.,

   ![Diagram 4](image4)
Repeat for more than 1 digit card. Use 0 cards, e.g.:

8m, 7cm

Put in zero:
807cm

Move 7 to the left:
8m 70cm, 870cm

Note: If difficulty with the above, place all cards on wall with hundreds, tens and ones visible as well as 1m, 10cm and 1cm, e.g.

<table>
<thead>
<tr>
<th>hundreds</th>
<th>tens</th>
<th>ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>10cm</td>
<td>cm</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

(3) Put out all cards

<table>
<thead>
<tr>
<th>hundreds</th>
<th>tens</th>
<th>ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>10cm</td>
<td>cm</td>
</tr>
</tbody>
</table>
Place 1 digit under these and move around.

<table>
<thead>
<tr>
<th>hundreds</th>
<th>tens</th>
<th>ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>10cm</td>
<td>cm</td>
</tr>
</tbody>
</table>

Use calculators to work out what $x$, $\div$ relate to what movement.

Reverse: give movement (from 10cm to m) $\rightarrow$ find $x$, $\div$ (x10); give $x$, $\div$ (÷10) $\rightarrow$ find movement (from 10cm to cm).

(4) **Look at m being ones.** Put decimal point after m. What does this make? 10cm, cm?

Use digit cards and relate to ones, tenths and hundredths.

<table>
<thead>
<tr>
<th>ones</th>
<th>tenths</th>
<th>hundredths</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>10cm</td>
<td>cm</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Note – Can revert to cm, just depends on position taken on what is the one. Relate m and cm, e.g. 6.24m = 624cm.

Go both ways cm $\rightarrow$ m and m $\rightarrow$ cm. Discuss rule for conversion.

(5) **Play game “Decimal Wipeout”:**

“Decimal Wipeout”

**Materials:** Calculator, worksheet (if wanted).

**Directions:**

(1) One student gives a decimal number, e.g., 2.46m, and a digit, e.g., 4. Other students put 2.46 on calculator and remove 4 (e.g., make number 2.06) by a single subtraction, (e.g., −0.4). Other students state number subtracted and position in terms of PV and metrics. By worksheet, this is:

<table>
<thead>
<tr>
<th>Number</th>
<th>Digit</th>
<th>Subtraction</th>
<th>Final number</th>
<th>Metric position subtracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.46m</td>
<td>4</td>
<td>−0.4</td>
<td>2.06</td>
<td>10cm</td>
</tr>
</tbody>
</table>

-------------------------------------------------------------------
(6) Construct a m/cm slide rule. Use the rule to show how numbers/measure change when m or cm is the whole. Go from number → m/cm, and m/cm → number, e.g.:

```
<table>
<thead>
<tr>
<th>m</th>
<th>10cm</th>
<th>cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>
```

= 462cm or 4.62m

(7) Undertake worksheets relating m to cm and vice versa.
ACTIVITY 3 – CM ↔ M SLIDE RULE
Cut out slide and slides. Cut along dotted lines. Insert slides.
ACTIVITY 4

Objectives
(1) Combining 1000s, 100s, 10s, 1s, tenths, hundredths and thousandths.
Relating these PV positions to m, cm and mm.
Reinforcing PV relationships between adjacent positions hundreds → hundredths.
Reinforcing metric conversions m ↔ cm ↔ mm.

Materials
PV cards, digit cards, calculators.

Directions
(1) Make up new PV cards thousands, thousandths.

Get out PV cards from Activities 1, 2 and 3. Use students to place these in order. Put in decimal point.

Discuss why they go in this order. Look at symmetry around ones.
Use other students holding digit cards to represent different numbers. Fill in gaps with zero cards.

Go in both directions: representation → numbers, and numbers → representation: also give decimal numbers, e.g., 4.2, 37, 45.06, 2400.402, and represent with digit cards.
Play “Decimal wipeout”

“Decimal Wipeout”

Materials: Calculator, worksheet (if wanted).

Directions:

(1) One student gives a decimal number/measure of 6 digits and 3 decimal place values, e.g., 287.461m, and a digit, e.g., 6. Other students put 287.461 on calculator and remove 6 (e.g., make number 287.401m) by a single subtraction, (e.g., – 0.06). Other students state number subtracted and position in terms of PV and metrics. By worksheet, this is:

<table>
<thead>
<tr>
<th>Number</th>
<th>Digit</th>
<th>Subtraction</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>287.412</td>
<td>8</td>
<td>– 80</td>
<td>307.41</td>
</tr>
<tr>
<td>246.834</td>
<td>3</td>
<td>– 0.03</td>
<td>246.804</td>
</tr>
</tbody>
</table>

Also do examples with 2 digit positions to wipe (e.g., 347.642 – wipe out both 4s).

Put a digit card in front of PV cards. Move digit card left and right. Track movements with calculator seeing relation between movement L & R and x, ÷10. Go both ways – give x and ÷, find movement; give movement, find x, ÷.

Write down rule for x10, ÷10. Write down rule for moving left and moving right.

Put thousand → thousandths PV cards on wall. Place m, cm, mm cards under these so that (a) m is ones, (b) cm is ones, (c) mm is ones.

Fill in gaps with cards 10cm, 10m and 100m. Find value of 5m, 6cm, 4mm for (a), (b) and (c).

Construct super slide rule 1. Use super slide rule 1 to change. Use 2 slide rules together.

(a) 2.438m to cm and mm
(b) 8256.2cm to m and mm
(c) 17048mm to m and cm
Play game “The Big One”.

“The Big One”

Materials: Calculator

Number of players: 2

Directions:

(1) 1st player chooses a number between 9 and 100 (does not reveal this to opponent) and enters on his/her calculator $\text{choice ÷ choice} = $ (this give 1 on the calculator). The calculator is then given to the 2nd player. The 2nd player puts $\text{guess} = \text{guess}$ until 1 appears (has guessed the number). Players take turns being the 1st and 2nd player. The winner is the player with the lowest number of guesses after 5 games.

(2) Players can set numbers between 9-100 with up to 2 decimal players (e.g., can choose a decimal number).

Undertake worksheet converting m ↔ cm ↔ mm.
ACTIVITY 4 – SUPER SLIDE RULE

Cut out slide and slides. Cut along dotted lines. Insert slides.
ACTIVITY 5

Objectives
(1) To introduce the pattern of 3s in PV of large numbers.
To relate pattern of 3s to relationships between measures.
To use relationships for metric conversion.

Materials
A5 cards, calculator.

Directions
(1) Look at numbers such as 356 872 913, break digits into threes, e.g., 356/872/913, recognise that right hand 3 digit are ones, middle 3 are thousands and left hand 3 digits are millions. Say as a series of 3 digit numbers (covering other 3 digit groupings as say the 3 digits in focus):

   e.g., 356 millions, 872 thousands and 913 ones.

(2) Construct following cards:

   Organise students to stand in order with PV cards. Get another student (or students) to move in front of PV cards with digit cards. Using zero cards where needed, get students to state numbers shown. Also reverse - start with numbers and ask students to show these with PV and digit cards.

(3) Place cards on wall

   Get students to place digits in front of PV and then move left (L) or right (R) one or more spaces. Use calculators to follow these movements by x, ÷ by 10/100/etc. as appropriate.

   Ensure work is both ways: show movement L/R → find x, ÷ by 10/100/etc.; show x, ÷ by 10/etc. → find movement L/R.

   Propose general rule for relating PV positions in terms of x, ÷.
(4) Play games: “Big Number Wipe Out” and “Target”

**“Big Number Wipe Out”**
Materials: Calculator, worksheet if necessary.
Number of players: 2
Directions:
(1) Same rules as ordinary wipeout but number can be up to 9 digits and digits to be removed could be in 2 or 3 different places. One student gives a decimal number/measure of 6 digits and 3 decimal place values, e.g., 346 247.461m, and a digit, e.g., 4. Other students put 346 247.461 on calculator and remove all 4s6 (e.g., make number 306 207.061) by a single subtraction, (e.g., \(-40\ 040\).4). Other students state number subtracted and position in terms of PV and metrics.

(2) Can use a worksheet as below.

<table>
<thead>
<tr>
<th>Number</th>
<th>Digit(s)</th>
<th>Subtraction</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>68 474 214</td>
<td>4</td>
<td>– 40 004</td>
<td>68 070 210</td>
</tr>
</tbody>
</table>

**“Target”**
Materials: Calculator, worksheet if necessary.
Number of players: 2
Directions:
(1) Give students a starting number and a target number, e.g. 37 and 9176. Enter \(37\) in calculator. Then press guess \(\Rightarrow\), guess \(\Rightarrow\), until get the target. (No pressing of “clear all”). Students take turns being the starting number provider. After 5 goes each, the winner is the student with the lowest number of guesses.

(2) Can be done with worksheet, e.g.

<table>
<thead>
<tr>
<th>(1) Number</th>
<th>Target</th>
<th>Too high</th>
<th>Too low</th>
<th>Current guess</th>
<th>Number of guesses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(5) Put the following cards in front of millions → ones on wall, like so:

<table>
<thead>
<tr>
<th>H</th>
<th>T</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>km</td>
<td>km</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H</th>
<th>T</th>
<th>O</th>
<th>H</th>
<th>T</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>m</td>
<td>m</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Millions</th>
<th>Millions</th>
<th>Millions</th>
<th>Thousands</th>
<th>Thousands</th>
<th>Thousands</th>
<th>Ones</th>
<th>Ones</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>T</td>
<td>O</td>
<td>H</td>
<td>T</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Organise students with digit cards to stand in front of both and move L and R. Look particularly at relationships between:
Propose what is needed for conversions, e.g. m \rightarrow \text{mm}, m \rightarrow \text{km}, in terms of \times, \div.
Repeat for \text{t/kg/g} and \text{L/L/mL} conversions.

(6) Reinforce relating the pattern of 3s to metrics with the “Pattern of 3’s slide rule”. Use strips to relate km/m/cm, \text{t/kg/g} and \text{L/L/mL}. (\text{Note: The slide rule is available from the virtual material attached to this booklet.})

Begin with km/m/mm. Add in decimal point at m. How does this change things? (e.g. mm \rightarrow m as ones). Do a similar change for decimal point at km.

Repeat for \text{t/kg/g} and \text{L/L/mL}.

Propose rules for the changes in these 3 relationships.

(7) Undertake worksheets to practice these conversions.
SECTION 2: USING PERIMETER AND AREA TO TEACH OPERATIONS

Unit 1: Addition and subtraction

This unit will use measurement of length and perimeter to introduce addition and subtraction of 2 and 3 digit numbers by the sequencing mental computation strategy. Both additive and subtractive sequencing strategies for subtraction will be included.

Activity 1
Activity 2
Activity 3
Activity 4

Unit 2: Multiplication and division

This unit will use measurement of area by array or “area” methods to introduce multiplication up to 3 digits by 1 digit and division up to 3 digits divided by 1 digit.

Activity 1
Activity 2
Activity 3
Activity 4
Unit 1: Addition and Subtraction

Using length and perimeter to introduce 2-3 digit addition and subtraction.

ACTIVITY 1

Objectives
(1) Counting forward and backward by 10
(2) Counting forward and backward through 10

Materials
Metre ruler/tape, 10cm length

Directions
(1) Look at metre ruler/tape. Count forward and back by 10cm.
(2) Find 10cm more and 10cm less than
   (a) 37cm  (b) 63cm  (c) 89cm.
   To do this, take the number, say 43cm. Find this on ruler/tape and measure what is 10cm more, 10cm less. Check answer with 10cm length.

(3) Count on to over 100 by 10cm from
   (a) 37cm  (b) 11cm  (c) 24cm.
   Count back to zero by 10cm from
   (a) 92cm  (b) 86cm  (c) 78cm.
   Play game “coin toss”.

“Coin toss”
Materials: 1 coin, deck of cards (1-9)
Number of players: 2
Directions: Draw 2 cards. Make the number shown the starting point. Players in turn throw coin. Heads add 10. Tails subtract 10. The winner is the player with highest number after 7 goes for each player.

(4) Calculate
   (a) 4cm more than 28cm  (b) 6cm more than 55cm
   (c) 8cm more than 47cm.
To do this, say for example 5 cm more than 37 cm, look at 37 on ruler. Move to next 10 (e.g. 40), then move the extra to make 5 (e.g., 37 + 3 = 40; 40 + 2 = 42). E.g.,:

<table>
<thead>
<tr>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>37</td>
<td>40</td>
<td>42</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(5) Calculate

   (a) 3 less than 31   (b) 5 less than 42   (c) 7 less than 83.

To do this, say for example 4 less than 52, look at 52 on ruler. Move back to the previous 10 (e.g., 50), then move back the extra to make 4 (e.g., 52 − 2 = 50; 50 − 2 = 48).

<table>
<thead>
<tr>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>48</td>
<td>50</td>
<td>52</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(6) Play game “card and coin toss”.

“Card and coin toss”
Materials: 1 coin, deck of cards (1-9)
Number of players: 2
Directions: Start at 50. Players in turn throw coin and draw a card. Heads add 10 plus the ones from card. Tails subtract 10 and the ones from card. The winner is the player with highest number after 7 turns for each player.
**ACTIVITY 2**

**Objectives**

1. To measure distances in centimetres
2. To add two 2-digit numbers/measures using the sequencing strategy
3. To calculate perimeter

**Materials**

Metre tape or ruler, objects to measure, number line (0-100)

**Directions**

1. Measure the 6 objects A, B, C, D, E & F as directed by your teacher. (These objects each less than 50cm, so total of two of them is not greater than 100cm)
   
   To measure distances in cm, place tape/ruler along object, align 0cm with one end and read length in cm (to nearest cm)

2. Find
   
   (a) A + B  
   (b) C + D  
   (c) E + F

   To find the joint measure of two objects, say A and B, measure the first object A from 0, mark where ends, then keep this as start for second object B. The sum is the end of the second object. E.g.,

   ![Diagram of measuring A and B]

   44cm \( \rightarrow \) A

   ![Diagram of measuring B]

   89cm \( \rightarrow \) A + B

3. Calculate by thinking ruler/tape:

   (a) 47cm + 32cm  
   (b) 36cm + 28cm  
   (c) 45cm + 28cm  
   (d) 46cm + 47cm.

   Thinking ruler/tape requires imagining how a ruler/tape could be used for addition. Use a number line to help.
Example: 47cm + 32cm
– think of a metre ruler/tape

| 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

– put first distance on the metre ruler/tape as the start of adding the second distance

| 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

– then jump along the second distance (note it is 3 tens and 2 ones)

| 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

– total is: \( 47 + 30 = 77; 77 + 2 = 79 \)

Note: this has a written algorithm as on right.

\[
\begin{align*}
47 + 30 & = 77; \\
77 + 2 & = 79
\end{align*}
\]

Now extend this to examples which go past the 10, for example: 36cm + 38cm. Note the use of two jumps to get from 56 to 64.

| 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

Note: this also has a written algorithm as on right.

\[
\begin{align*}
36 + 20 & = 56; \\
56 + 8 & = 64
\end{align*}
\]

(4) Measure and calculate the distance around 3 shapes given to you by your teacher. Use the “think ruler/tape”.

Example:

\[
\begin{align*}
23 & \quad 16 & \quad 34 & \quad 15 \\
16cm & \quad 23cm & \quad 34cm \\
23 & \quad 33 & \quad 39 & \quad 49 & \quad 59 & \quad 69 & \quad 73 & \quad 83 & \quad 88 \\
15cm & \quad 15cm & \quad 15cm \\
0 & \quad 5 & \quad 10 & \quad 15 & \quad 20 & \quad 25 & \quad 30 & \quad 35 & \quad 40 & \quad 45 & \quad 50 & \quad 55 & \quad 60 & \quad 65 & \quad 70 & \quad 75 & \quad 80 & \quad 85 & \quad 90 & \quad 95 & \quad 100
\end{align*}
\]

(5) Distance around is called perimeter. Undertake a worksheet to find the perimeter of a series of shapes. Use the “think ruler/tape” method.
ACTIVITY 2 – NUMBER LINES 0-100

Use these number lines when beginning.
ACTIVITY 2 – BLANK NUMBER LINES 0-100

Use these number lines when more confident.
**ACTIVITY 3**

**Objectives**

1. To subtract two 2-digit numbers using the sequencing strategy (two methods)
2. To calculate length when know a total or a perimeter

**Materials**

Metre ruler/tape, objects to measure

**Directions**

1. Measure 6 objects P, Q, R, S, T, U as directed by your teacher (P, R and T between 50-100cm and Q, S and U under 50cm).

   Calculate:

   (a) $P - Q$
   (b) $R - S$
   (c) $T - U$

   To do this, place the first and longer object P alongside the ruler/tape with 0 aligned. Then place Q under P with end aligned with P. The answer will be the start of Q. E.g.,:

2. Calculate using the “think ruler/tape” strategy:

   (a) $95cm - 52cm$
   (b) $47cm - 25cm$
   (c) $82cm - 57cm$
   (d) $75cm - 28cm$

   To do this, imagine that a number line is the ruler. Use example $63cm - 26cm$

   - think of the metre ruler/tape
   - put first and larger distance on the ruler as the start of subtracting the second distance
   - then jump back the second distance on the ruler/tape (note that it is 2 tens and 6 ones); note the use of 2 jumps to get from 43 to 37 through 40.

   **Note:** This has a written algorithm as on right:
(3) If students have difficulty with “think ruler/tape” strategy, try the “build up” strategy.

Use examples

(a) 65cm − 41cm  
(b) 53cm − 25cm  
(c) 81cm − 33cm  
(d) 94cm − 49cm.

The “build up” strategy means measuring the longer and shorter object from 0cm and then working out the difference. For example 64cm − 26cm, this is:

To do this on number line, think like this:

– think of metre ruler/tape

– put both distances on the ruler/tape, e.g.,

– move from 26 to 64 in a series of jumps (move to nearest 10 and then on to larger number), e.g.,

– add the 10s and 1s (e.g., 10 + 10 + 10 + 4 + 4 = 38) to get answer 38cm.

Note: This has a written algorithm as on right

26
30
60
64
4

(4) Calculate the third side in these perimeter or “distance around” situations. Use either the “think ruler/tape” strategy or the “build up” strategy (discuss the steps):

(a) 36cm  
23cm  
23cm  
Perimeter = 81cm

(b) 38cm  
24cm  
Perimeter = 97cm
To do these. Have to calculate in two steps as follows. For example, the following is completed as follows:

Step 1: 31cm + 16cm

Step 2: 72cm – 47cm

Step 3: Answer is 25cm.

(5) Calculate the missing sides on the following rectangles. Use either the “think ruler/tape” or the “build up” strategy (discuss the steps):

(a) Perimeter = 92cm

(b) Perimeter = 96cm

Again, this is a three step process

Step 1: 27 + 27

Step 2: 96-54

Step 3: 42 is the length of both sides, one side = ½ of 42 = 21cm

(6) Undertake a worksheet, using either strategy, of perimeter activities for rectangles and triangles.
ACTIVITY 3 - LENGTHS

Photocopy to A3 and/or A2 sizes so that shapes are 50-90cm in length
ACTIVITY 4

Objectives
(1) To add and subtract 3-digit numbers using either/both of the two methods
(2) To find perimeters from lengths and lengths from perimeters when measuring in millimetres (0 – 1000)

Materials
Metre ruler/tape (in mm), number lines (open 0 – 1000)

Directions
(1) Calculate using the think ruler/tape” method on a number line:
   (a) 385mm + 212mm  (b) 468mm + 327mm
   (c) 584mm + 342mm  (d) 246mm + 495mm

   The way to do this is as follows. Use example 277mm + 348mm:
   – Place first number, e.g. 277, on number line

   277

   – add on second number, e.g. 348, by jumping 3 100s, 4 10s and 8 1s in many steps

   277

   or a few steps

   277

   – use a written algorithm as on right:

   \[
   \begin{array}{c}
   277 \\
   + 300 \\
   \hline
   577 \\
   + 40 \\
   \hline
   617 \\
   + 8 \\
   \hline
   625
   \end{array}
   \]
(2) Calculate 612mm − 247mm by two methods:

"Think ruler/tape"
- Mark larger number
- move back 247
- use algorithm

“Build up”
- mark both numbers
- work out difference
- use algorithm

(3) Use your chosen methods to do the following (discuss the steps involved):

(a) 268mm

Find ? when the perimeter of both Δs is the same!

(b) 268mm

Find ? when the perimeter is 908mm!

To do type (a) problems, for example, for

Step 1: calculate perimeter of first triangle

Step 2: calculate the sum of first 2 numbers on right hand triangle
Note: could have done the following

Step 3: Subtract the sum of 2 sides from perimeter (e.g. 751-637)

“Think ruler tape”

To do type (b) problems, for example, for Perimeter is 908mm

Step 1: add the 2 known sides (e.g. 147 + 147)

Step 2: subtract from perimeter (e.g. 908 – 294)

= 614mm

Step 3: 614mm is two equal sides, one side, the 

(4) Complete worksheets A and B of addition/subtraction activities.
ACTIVITY 4 – WORKSHEET A

A

\[\text{Perimeter} = \text{______________}\]

B

\[\text{Perimeter} = \text{______________}\]

C

\[\text{Perimeter} = \text{______________}\]

D

\[\text{Perimeter} = \text{______________}\]

E

\[\text{Perimeter} = \text{______________}\]

F

\[\text{Perimeter} = \text{______________}\]
ACTIVITY 4 – WORKSHEET B

A

30mm

Perimeter = 200mm

B

25mm

Perimeter = 70mm

C

30mm

40mm

Perimeter = 120mm

D

30mm

40mm

Perimeter = 95mm

E

15mm

15mm

Perimeter = 250mm

F

35mm

35mm

Perimeter = 140mm

G

100mm

Perimeter = 240mm

80mm
Unit 2: Multiplication and Division

Using area to introduce multiplication (up to 3 digits × 1 digit) and division (up to 3 digits ÷ 1 digit)

ACTIVITY 1

Objectives

(1) Introduce area of rectangles as an array of squares
(2) Reinforce array is multiplication and so area of rectangle is length x height
(3) Use distributive law to deconstruct larger arrays

Materials

Centicubes (or cm² tiles), metre ruler/tape, rectangle shapes, calculator, cm graph paper

Directions

(1) Calculate the area in cm² of rectangles constructed from

(a) 4 rows of 3 cubes
(b) 6 rows of 5 cubes
(c) 4 rows of 7 cubes
(d) 9 rows of 14 cubes

To find this area, for say 3 rows of 5 cubes, do the following:
– notice that the cubes are 1cm x 1cm = cm² (measure them)
– make the 3 rows
– notice that a rectangle is formed
– add the 3 rows of cubes (e.g. 5 + 5 + 5 = 15 cm²)
– notice that this is 3 lots of 5 or 3 x 5
– notice that 3 is height and 5 is length of rectangle

(2) Find the area of these rectangles:

(a) 4 cm x 5 cm
(b) 3 cm x 8 cm
(c) 6 cm x 7 cm
(d) 11 cm x 16 cm

To find these areas, take the pattern from (1) above as follows:
– draw the rectangles in cm graph paper
  (for example, 5 cm by 7 cm)
– notice this is 5 rows of 7 cm squares
– relate to multiplication (area = 5 x 7 cm²)
– use calculator to solve this.
(3) Calculate the following areas:

(a) 
\[
\begin{array}{c}
6cm \\
4cm \\
7cm \\
3cm
\end{array}
\]

(b) 
\[
\begin{array}{c}
5cm \\
8cm \\
3cm \\
12cm
\end{array}
\]

(c) 
\[
\begin{array}{c}
8cm \\
7cm \\
11cm \\
4cm
\end{array}
\]

To do these, consider them as two parts as for example:

\[
\begin{array}{c}
8cm \\
9cm \\
15cm
\end{array}
\]

– consider each part separately

\[
\begin{array}{c}
8cm \\
9cm
\end{array}
\]

\[
\begin{array}{c}
15cm \\
9cm
\end{array}
\]

– use arrays and multiplication to work out each area (use a calculator if needed)

\[
9 \times 8 = 72cm^2 \quad 9 \times 15 = 135cm^2
\]

– add the areas

Undertake a worksheet to cover the ideas above.
**ACTIVITY 2**

**Objectives**
1. Introduce 2 digit x 1 digit and 3 digit x 1 digit multiplication using area
2. Relate basic facts to algorithm process

**Materials**
1cm graph paper *(Note: need a special 1cm graph paper with light/dark cm lines)*

**Directions**

1. Calculate by using basic facts (no calculator):
   
   (a) 4 x 40
   (b) 8 x 20
   (c) 9 x 70.

   Do this by “think area” as the following example of 5 x 30 shows:
   
   - translate 5 x 30 to a 5cm x 30cm array
   - break this into 3 parts
   - work out each part as a multiplication and add
     
     \[50cm^2 + 50cm^2 + 50cm^2 = 150cm^2\]
   - notice 5 x 3 = 15, so 5 x 3 tens = 15 tens, so 5 x 30 = 150

   Work out the pattern for these types of multiplication, e.g., 6 x 70 = (6x7)0

2. Calculate by “think array” and by using basic facts only (no calculator):
   
   (a) 3 x 24
   (b) 7 x 63
   (c) 8 x 95.

   To do this follow the steps as for example 6 x 74:
   
   - think of a 6 x 74 array (note that 74 is 7 tens and 4 ones, or 70 and 4)
   - break array into 2 parts
   - do both parts separately
\[
6 \times 70 = 6 \times 7 \text{ tens} = (6 \times 7) \text{ tens} = 420 = 6(70) = 420 \quad \text{[}(6 \times 7)0\text{]} \\
\ \text{– add the two parts} \quad 420 + 24 = 444
\]

\[
\begin{array}{c}
420 \\
440 \\
444
\end{array}
\]

\[
\text{– see this as a sequence of steps:}
\]

\[
6 \times 74 \text{ is} \\
6 \times 20 = (6 \times 7) \text{ tens} = 420 \\
6 \times 4 = 24
\]

\[
\begin{array}{c}
440 \\
444
\end{array}
\]

Note these two ways of setting out algorithms

\[
\begin{array}{c}
\times \ 6 \\
420 \\
24
\end{array} \\
6 \times 7 \text{ tens} \\
\begin{array}{c}
24 \\
6 \times 4
\end{array}
\]

\[
\begin{array}{c}
420 \\
440 \\
444
\end{array} \\
6 \times 7 \text{ tens} \\
\begin{array}{c}
24 \\
6 \times 4
\end{array}
\]

(3) Calculate by “think array” and by using basic facts only (no calculator):

(a) 3 \times 268 \\
(b) 2 \times 473 \\
(c) 7 \times 139,

This is done as shown in example 3 \times 285:

\[
\begin{array}{c}
3 \times 285 \\
3 \times 200 \\
3 \times 80 \\
3 \times 5
\end{array}
\]

\[
\begin{array}{c}
200 \\
80 \\
5
\end{array}
\]

\[
\begin{array}{c}
600 \\
240 \\
15
\end{array} \\
3 \times 200 \\
3 \times 80 \\
3 \times 5
\]

\[
\begin{array}{c}
600 \\
240 \\
15
\end{array} \\
3 \times 200 \\
3 \times 80 \\
3 \times 5
\]

\[
\text{– use setting out as follows:}
\]

\[
\begin{array}{c}
285 \times 3 \\
600 \leftarrow 3 \times 200 \\
240 \leftarrow 3 \times 80 \\
15 \leftarrow 3 \times 5
\end{array} \\
600 \leftarrow 3 \times 200 \\
240 \leftarrow 3 \times 80 \\
15 \leftarrow 3 \times 5
\]

\[
\begin{array}{c}
855 \\
855
\end{array}
\]

\[
\text{– focus on how the arrays lead to a thinking that enables the multiplication to be completed – mentally, and by pen and paper.}
\]

(4) Undertake a worksheet covering the material above.
ACTIVITY 3

Objectives
(1) Introduce finding number in each row of an array as division
(2) Use “think arrays” to do division (up to 3 digit ÷ 1 digit)

Materials
1cm graph paper, centicubes

Directions
(1) Calculate the number of cubes in each row:
   (a) 18 cubes, 3 rows  (b) 32 cubes, 4 rows  (c) 54 cubes, 9 rows
   To do this, use centicubes as for example 12 cubes, 4 rows:
   – start making 4 rows with the centicubes
   – put one cube in each row until run out of cubes
   – notice that answer 3 is such that 4 x 3 = 12
   – notice that sharing cubes into the 4 rows so actually finding 12 ÷ 4 = 3

(2) Calculate by using the “think array” method:
   (a) 27 ÷ 3   (b) 28 ÷ 20   (c) 40 ÷ .8
   To do this, think as for example 36 ÷ 4:
   – think of 36 cubes being put into 4 rows
   – think 4 x ? = 36 or 36 ÷ 4 = ?
   – calculate 36 ÷ 4 [=9].

(3) Complete by using “think array” method (basic facts only – no calculator).:
   (a) 96 ÷ 3   (b) 144 ÷ 6   (c) 296 ÷ 8
   To do this, do as for example 84 ÷ 4:
   – think of forming a rectangle
ask yourself, are there 10 in each row, 20 in each row, 30 in each row? - stop at largest number of tens that could be in each row [here, 20] – break up the rectangle using that number of tens as follows (2 options – the 20 or 10 and 10)

- now think, what can the ? be? – it is what is left – the tens use 40 and 40 or 80 - so 4 cubes are left over - so 1 more in each row – making the answer 21.

Note: Can represent this as a written algorithm using two methods of setting out as below:

<table>
<thead>
<tr>
<th>SHAREAlGORITHM</th>
<th>GROUPING ALGORITHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4 \overline{21}$</td>
<td>$4 \overline{84}$</td>
</tr>
<tr>
<td>tens (8ten ÷ 4) $\rightarrow$ 80</td>
<td>40 10 in each row</td>
</tr>
<tr>
<td>ones (4÷1) $\rightarrow$ 4</td>
<td>40 10 in each row</td>
</tr>
<tr>
<td>0</td>
<td>4 1 in each row</td>
</tr>
<tr>
<td>4</td>
<td>0 21</td>
</tr>
</tbody>
</table>

(4) Complete by array method

(a) $657 \div 9$  (b) $872 \div 4$  (c) $837 \div 3$.

To do this, follow steps as for $716 \div 4$:

- think of an array and forming a rectangle of 4 rows

- ask are there any 100s (yes at least one) so divide rectangle into two parts

- ask if this is all the hundreds (yes) - if so, how much is left?

- think about this remaining numbers are there at least 10 in each row, 2 tens, 3 tens and so on (yes there are 7 tens), so divide rectangle again and work out how much is left
Note: can be more than one step, for example:

4

<table>
<thead>
<tr>
<th>100</th>
<th>30</th>
<th>30</th>
<th>10</th>
<th>?</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>120</td>
<td>120</td>
<td>40</td>
<td>36</td>
</tr>
</tbody>
</table>

– now look at \( \underline{36} \) and realise this is \( 36 \div 4 = 9 \), so

4

<table>
<thead>
<tr>
<th>100</th>
<th>70</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>280</td>
<td>36</td>
</tr>
</tbody>
</table>

Note: the 2 methods of setting out for the algorithm:

4 | 179
---|---
| 716

\[
\begin{array}{c}
\text{hundreds \((7\div4)\)}
\end{array}
\]

400
316

\[
\begin{array}{c}
\text{tens \((31\div4)\)}
\end{array}
\]

280
36

\[
\begin{array}{c}
\text{ones \((36\div4)\)}
\end{array}
\]

36

\[
\begin{array}{c}
0
\end{array}
\]

\[
\begin{array}{c}
400 \quad 100 \text{ in each row}
\end{array}
\]

\[
\begin{array}{c}
316
\end{array}
\]

\[
\begin{array}{c}
120 \quad 30 \text{ in each row}
\end{array}
\]

\[
\begin{array}{c}
196
\end{array}
\]

\[
\begin{array}{c}
120 \quad 30 \text{ in each row}
\end{array}
\]

\[
\begin{array}{c}
76
\end{array}
\]

\[
\begin{array}{c}
40 \quad 30 \text{ in each row}
\end{array}
\]

\[
\begin{array}{c}
36
\end{array}
\]

\[
\begin{array}{c}
36 \quad 9 \text{ in each row}
\end{array}
\]

\[
\begin{array}{c}
0 \quad 170
\end{array}
\]

(5) Undertake a worksheet on these activities.
ACTIVITY 4

Objectives
(1) Use array method to calculate length/height of rectangle when given area and height/length
(2) Extend this method to triangles

Materials
Drawings on paper

Directions

(1) Calculate length when given height and area
   (a) \( 5 \text{cm} \quad 135 \text{cm}^2 \)  
   (b) \( 6 \text{cm} \quad 228 \text{cm}^2 \)  
   (c) \( 8 \text{cm} \quad 472 \text{cm}^2 \)

To do this, “think array” as in example:

\[
\begin{array}{c|c}
7 \text{cm} & 224 \text{cm}^2 \\
\hline
30 \text{cm} & \text{?} \\
210 \text{cm}^2 & 14 \text{cm}^2 \\
32 \text{cm} & 224 \text{cm}^2 \\
7 \text{cm} & 224 \\
224 & 210 \\
210 & 14 \\
14 & 2 \\
14 & 32 \\
0 & \\
\end{array}
\]

– how many tens (\( 7 \times 30 = 210 \))

– how many ones (\( 7 \times 2 = 14 \))

\[
\begin{array}{c}
7 \quad 224 \\
210 \\
14 \\
14 \\
0 \\
\end{array}
\]

\[
\begin{array}{c}
32 \\
210 \\
14 \\
14 \\
0 \\
\end{array}
\]

(2) Calculate height when given length (using “think array” method)
   (a) \( 652 \text{cm}^2 \)
   (b) \( 864 \text{cm}^2 \)
   (c) \( 765 \text{cm}^2 \)

To do this, “think arrays” as follows for example (no calculator, basic facts only):

– think side array

\[
\begin{array}{c|c}
? & 826 \text{cm}^2 \\
100 \text{cm} & 700 \text{cm}^2 \\
7 \text{cm} & 7 \text{cm} \\
\hline
? & 126 \text{cm}^2 \\
100 \text{cm} & 700 \text{cm}^2 \\
7 \text{cm} & 7 \text{cm} \\
\hline
? & 56 \text{cm}^2 \\
10 \text{cm} & 70 \text{cm}^2 \\
7 \text{cm} & 7 \text{cm} \\
\hline
8 \text{cm} & 56 \text{cm}^2 \\
10 \text{cm} & 70 \text{cm}^2 \\
7 \text{cm} & 7 \text{cm} \\
\hline
118 \text{cm} & 826 \text{cm}^2 \\
\end{array}
\]

– complete algorithm
(3) Calculate areas of triangles using “think array” (and no calculator – basic facts only):

(a) 

To do this, use “think arrays” as in example of triangle height 34cm, length 9cm:
– consider two triangles
– cut one triangle in parts perpendicularly
– rearrange the parts, see that 2 triangles makes 1 rectangle of same length and height
– make the rectangle with same length and height and break into parts based on place value

– total is $\frac{34 \times 9}{2} = 153\text{cm}^2$
(4) Calculate length/height of triangle when given area and height/length (the other measure) for the following:

(a) \[ \text{Area} = 278 \text{ cm}^2, \text{height} = 9 \text{ cm} \]

(b) \[ \text{Area} = 365 \text{ cm}^2, \text{base} = 5 \text{ cm} \]

(c) \[ \text{Area} = 278 \text{ cm}^2, \text{base} = 4 \text{ cm} \]

To do this, note that two triangles make one rectangle. So look at rectangle. For example:

- construct associated rectangle (area is double)

\[
\begin{array}{c|c|c}
6\text{cm} & 762 \text{ cm}^2 & ?\text{cm} \\
\end{array}
\]

- see this as \( 762 \div 6 \)

\[
\begin{array}{c|c|c|c|c}
100\text{cm} & ?\text{cm} & 600 \text{ cm}^2 & 162 \text{ cm}^2 \\
6\text{cm} & & \\
\end{array}
\]

\[
\begin{array}{c|c|c|c|c}
100\text{cm} & 20\text{cm} & ?\text{cm} & 120 \text{ cm}^2 & 42 \text{ cm}^2 \\
6\text{cm} & & & \downarrow & \\
\end{array}
\]

\[
\begin{array}{c|c|c|c}
100\text{cm} & 20\text{cm} & 6\text{cm} & 600 \text{ cm}^2 & 120 \text{ cm}^2 & 42 \text{ cm}^2 \\
6\text{cm} & & & & \downarrow & \\
\end{array}
\]

- that is \( 6 \div 762 \)

\[
\begin{array}{c|c|c|c|c|c}
600 & 100 & \text{in each row} \\
162 & 20 & \text{in each row} \\
120 & 7 & \text{in each row} \\
42 & 0 & \text{in each row} \\
42 & & & & & \downarrow \\
0 & & & & & 127 \\
\end{array}
\]

(5) Undertake a worksheet on triangle work.
SECTION 3: MEASURING TO BUILD AN “AIM HIGH – BEAT YOURSELF” (AH-BY) PROGRAM

Unit 1: Describing an AH-BY program

This unit describes an AH-BY program and discusses its effects on Indigenous identity and engagement.

Activity 1
Activity 2

Unit 2: Applying an AH-BY program

This unit proposes a way in which an AH-BY program could operate alongside the measurement activities in Sections 1 and 2 and suggests some classroom activities.

Activity 1
Activity 2
Unit 1: Describing an AH-BY Program

Describing a program and discussing effects.

In the finance trials, some teachers (feeling that money was a useful way to motivate and teach mathematics) set up weekly programs involving students undertaking financial activities. The best of these had:

1. daily allowance for attendance plus bonuses/fines for good/not so good work;
2. a day where money earned was given to students and they could draw it out of a “bank” to “buy” things in shops (things included lollies, school materials, time on games, and larger items); and
3. some regular payment of weekly costs (e.g., power, rent, etc.), some necessity to replace classroom materials from shop before buying other items, and some encouragement to save for larger items.

This booklet is to propose something similar to this to run alongside the measurement materials. A possibility is a daily program that involves students in doing things they can measure which they compare against their own previous days’ achievement in the same area. It is based on high expectations to improve each day over what the students do themselves previously (with no comparison with other students) – thus the name “Aim high – Beat yourself”.

BASIS OF AH-BY APPROACH

Successful Indigenous school programs build pride, confidence and self worth in Indigenous students and challenge them to perform. Teaching programs can improve Indigenous students’ mathematics learning outcomes if they reinforce pride in Indigenous identity and culture, encourage attendance, highlight the capacity of Indigenous students to succeed in mathematics, provide a relevant educational context, and expect students to perform. There is some evidence that Indigenous students’ low performance in mathematics appears to be because of: (1) failures to make mathematics culturally appropriate, and (2) systemic beliefs that the gap in educational outcomes between Indigenous and non-Indigenous students is “normal” and that educational equality for Indigenous Australians is either not achievable, or only achievable over a long period of time.

An AH-BY program involves two things: (1) setting goals for Indigenous students that are much higher than what is normally expected in many Indigenous schools; and (2) assisting students to achieve these goals by processes that only involve comparison within a student (against what they achieve in previous days) and which have a good chance of showing improvement. An AH-BY program would normally begin in a school area (e.g., sport) where there was student interest and then spread to other areas. It may involve affective as well as cognitive outcomes (e.g., improvement in behaviour or increased levels of engagement). The successful AH-BY program on which this section is based was effective in a situation where students do not wish to appear different to their classmates and was only implemented in one class.
The idea for the AH-BY program came from a young non-Indigenous teacher at his first teaching post, thus it can be successfully used by inexperienced non-Indigenous teachers and have effect in one classroom.

BACKGROUND

The idea for AH-BY came from a belief that it is important: (1) for students to be responsible for their own learning; (2) for classrooms to focus on process and not answers; and (3) for teachers to build confidence and motivation by setting expectation students can reach. It was based on involvement with the local Indigenous community and started with a strong interest of that community, sport. It involved a partnership with an experienced teacher aide, with little knowledge of mathematics but with knowledge of Indigenous culture, with whom students were comfortable enough to take risks. It was based on a belief that, for his students, the best thing he, as a non-Indigenous teacher, could do was to get the students to focus on “beating themselves” not each other, to ignore winning and losing and to focus on doing their best.

The AH-BY program began by reshaping the students' view of winning:

they'd always get to the end of the race, ... who won? ... I said that person won because they're the tiredest. ... if you haven't tried your hardest, you haven't won.

It was based initially on sport:

I keep trying to challenge them, and to push themselves ... I use Cathy Freeman as an example ... she trains by herself, so how does she win? ... she's got to beat herself

Then activity moved to measuring and graphing their own sport times and distances – graphs were restricted to comparisons of their measurements against their earlier measurements:

... I wanted to motivate them, so I started with measurement, then we could go out and do measurement outside and stuff like that ... cause if there's any way you can motivate these kids, and build their confidence, it's through sport, ...

These graphs were then extended to literacy and numeracy, for example, to graphing the number correct in a basic-facts drill activity.

STUDENT RESPONSES

The students were initially performing at a low level:

... I know if I try to compare what the kids are achieving compared to kids from Brisbane that have got that really rich environment, both home and at school, you know like it’d just be depressing, you’d think that you’re a total failure but then at the same time you know that you’re not because the kids are still learning ...

This included graphing, particularly with respect to scales:

... they’re used to collecting data, but the graphing ... they’re good when you’re there with them, but ... to let them go and say you work out the measurements to go up the side, they’re just like, no idea.

However, there was success in sport, typified by this example:
There’s another girl from another school that has been flogging them all of their lives anyway so this 800 metres … they went off with this girl and as usual she got way out in front. And usually what would happen in the past, they’d just give up … This year, with teaching them “Aim High-Beat Themselves” … our girls just kept running and by the halfway through the second lap, they’d passed her!

This sporting success led to a change in the community. Previously high expectations had led to parent complaints of pushing “picking on kids”. Now parents supported high expectations, and some transfer from sport to academic activities had started:

… this boy that’s running well, I got his confidence up by praising him with his running and I knew he was smart in the class but he wouldn’t do anything and then all of a sudden he thought, I’ll have a go and he jumped 12 levels in a term …

On top of this, the students’ measuring and graphing skills improved, though scale remained a problem.

**DISCUSSION**

First, AH-By’s success reinforces findings elsewhere that Indigenous students’ mathematics performance can improve if instruction: (1) is integrated into generic programs that focus on building pride, confidence and self worth in Indigenous students and challenge them to perform, (2) involves and impacts on the community in general as well as the school, and (3) takes account of Indigenous culture, particularly its strengths, in a positive manner. AH-By initially took advantage of an important component of community life, sport, and then allowed high expectations to exist with practices that enabled the students to achieve success without shame. The focus on students’ own practice and the redefinition of winning as “doing your best” and improving on yesterday circumvented an aspect of Indigenous culture that has made it difficult for some Indigenous students to achieve in the competitive aspects of Western culture. It is particularly important for mathematics as it is a subject where success and failure are very public.

Second, AH-By’s success also provides some indication that involvement in a generic program is necessary but not sufficient for improving Indigenous students’ mathematics outcomes. Graphs on grid paper as a way of recording data was introduced but there had been no exploration of the meaning of scale through early work with squared paper. Therefore, although they used graphs in many situations, the students remained uncertain with respect to scale. Contextualisation, student identity and community support are undoubtedly important for Indigenous students to achieve success, but proficient teacher mathematics and pedagogic knowledge is still required for effective mathematics learning.
Unit 2: Applying an AH-BY Program

Some suggestions on how to integrate AH-BY into your teaching.

In the finance material, we developed a sequence of units that used financial activities to teach: (1) number and operations from 2-digit whole numbers to decimals to 2 or more-step word problems, and (2) financial mathematics from finding change to balancing a budget. This sequence was built around units developing skills, and a few special units that undertook “rich tasks” that culminated in the development of particular ideas.

In these measurement materials, we have split the material and provided:

(1) a resource booklet (the Measurement Background booklet) on how to use 5 stages (attribute, comparison, non-standard units, standard units, and formulae) to develop length, area, volume, mass, time, angle, temperature and money; and

(2) this resource booklet of 3 sections (the Measurement Activities booklet) on how to develop whole number algorithms (up to 3 digit + 3 digit, 3 digit – 3 digit, 3 digit × 1 digit, and 3 digit ÷ 1 digit).

This Activities booklet culminates with Section 3 that provides a framework, not for a culminating rich tasks, but for an ongoing program that runs beside both the measurement and number/operations work. This unit provides suggestions for this “alongside” program, called “Aim high – Beat yourself” (AH-BY).

FOCUS

The AH-BY program aims to reinforce two things in using measurement activities to teach number-operations work:

(1) to have this work done with high expectations for success; and

(2) to use this work to develop a new approach to success (that success is focusing on only one’s own progress, trying as hard as one can, and improving on what was done yesterday).

High expectations (“Aim high”)

The number/operations work has been set to simply assist students to undertake mental or pen-paper algorithms without a calculator (a part of 3-5-7 tests) that will allow them to comprehend and use two crucial models:

(1) the number line model (becoming common in years 3-5-7 tests and useful in algebra); and

(2) the array model (the major model for extending multiplication to decimals, fractions and algebra).

All students should be expected to do this work.
Success ("Beat yourself")

The measurement work can be used to undertake daily activities which can be compared and graphed against previous days with success being redefined as trying hard and being better than yesterday. This removes the stigma of comparison against other students and appearing either better or worse than other students. This form of success may be a better one for the high expectations. That is, to have high expectations of improvement and effort – not of being the “best student”.

ACTIVITIES

It is important that activities undertaken as part of AH-BY have the potential for improvement for all students who take them up. Some suggestions are as follows.

1. **Sporting activities**

   The suggestion is that you implement a sporting or health program with your students that involves measurement in a way that facilitates improvement. Ideas include:

   - running a set distance;
   - walking for a set time;
   - completing a number of activities (e.g., squats, push-ups, sit-ups, etc.)
   - doing an activity involving a distance (e.g., throwing, jumping, etc.)
   - and so on.

   This program should be worked out with students and with expert staff if available. Students’ measures should be graphed each day so that progress can be commented on. The focus should only be on how things changed with respect to previous days.

2. **Basic facts**

   Start a basic fact program. A good way to ensure that there is progress is to run the “four minute mile”. Develop a set of facts to be learnt (actually over-learnt or “automated”), put these in random order on a card, give the students 4 minutes each day to do as many as they can. After working, students graph their number correct against previous days’ results.

   It is important that two things extra are done:

   - that the facts to be over-learnt are first taught from a strategy approach so that students at least have a way of answering them (albeit slowly) that can be speeded up by the “four minute mile” (strategy clusters are a good way to go); and
   - errors found in marking should be recorded by each student and a practice time found for these errors to be learnt each day (on top of daily practice – important that “four minute mile” runs every day).

3. **Work Program**

   It is useful to set up a program of mathematics work that can be measured each day (for example, exercises attempted) for each child. This can also be graphed each day to show progress. Activities may have to be moderated (“2 of these is worth 6 exercises”) to ensure effort gives progress – in terms of the graph of achievement/effort going up when it should.

   There may be a need for a daily program to be designed in a way that good effort and some learning will, in most cases, give upward progress. It should also be noted that progress
need not be restricted to number of activities but can simply be a graph of progress across a unit of work showing activity with higher and harder exercises/problems.

4. **Tasks**

Another suggestion is to set a task program that involves the student doing more or working at higher levels. The program could involve increasing the number of exercises attempted, or moving up levels of achievement. This may have to be graphed on a weekly basis.

5. **Behaviour**

Setting goals for behaviour (or for engagement) can also be part of this approach. For example, reducing the number of behaviours that attract penalties, reducing swear words, or increasing minutes that work each day.

6. **Other KLAs**

Involve other KLAs in the program if you can. For example, reading or writing could be effective areas.

**SPREADSHEETS**

It would be good if computers could be used to record daily progress. In this way Excel can give the graphs relating students’ work with what they did on previous days.

Any staff not knowing how to set up, do or teach Excel should contact us and we should be able to arrange support.