

## Background information and acknowledgements

This series of diagnostic tools unpack student thinking around a small number of “big” ideas in Number. Unless students have deep and robust understandings of these Big Ideas their progress will be seriously impaired not just in the number strand but in mathematics generally. The tools and advice have a strong research base so teachers can be confident that the range of responses their students give to these diagnostic tasks will strongly correlate with those identified in the advice section. Teachers can then use the advice to plan learning activities that directly build on students’ current knowledge.

Currently, many students develop only a surface knowledge of key mathematical concepts relying on their ability to apply procedures they have been taught but being unsure why these procedures are appropriate. This procedural approach to mathematics can lead to short term success but does not provide a strong foundation on which to build long term success in mathematics learning.

For teachers to successfully support learning in mathematics, it is vital that they understand what students already know and target further learning to individual student needs. Building learning from students’ current mathematical understanding requires specialised assessment tools that reveal students’ thinking and then provide practical suggestions about learning activities appropriate to individual student’s learning needs. The diagnostic tools and advice provided within this folder have been designed for this purpose.

The tools and advice were developed by Professor Dianne Siemon of RMIT University, Melbourne for the Victorian Department of Education and Early Childhood Development. They have been reproduced here in their original form except for minor changes to formatting and the removal of links to the Victorian Essential Learning Standards (VELS). We are indebted to the Victorian Department of Education and Early Childhood Development for giving us permission to use these diagnostic tools and for their advice and cooperation.

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## Using the tools

Professor Dianne Siemon explains how to get the most out of these resources.

*Dear Teachers*

*These tools provide a set of easy-to-use diagnostic tasks that expose critical aspects of student thinking in relation to key aspects of Number, as it is this area that research has shown to be most responsible for the huge differential in student performance by the middle years. The tools also provide advice on targeted teaching responses to the ‘common misunderstandings’ and/or learning needs identified. They are particularly useful in identifying the learning needs of students who teachers believe are ‘at risk’ or likely to be at risk in relation to these important underpinnings. Equally however they can provide direction to teachers looking to extend particular students.*

*A small number of ‘stand-alone’ tasks are provided for each Big Idea. The tasks have been designed to be administered individually, and generally take between 5 and 10 minutes, which means that they can be used in class without withdrawing students (although sometimes this may be advisable). **Before using the tools, it is suggested that teachers read the related advice so that they are aware of likely responses.** As the whole point is to expose student thinking, not to assist student’s to get the ‘right answer’, teachers are strongly advised to resist the urge to teach during these episodes and to either terminate the conversation or move on to another task as soon as a student experiences difficulty.*

*Wherever possible, readily available classroom materials have been used. Cards can be reproduced as required or laminated and some additional resources have been provided to support the targeted teaching suggestions. While it might seem tedious to prepare the cards, it is important to use these with individuals rather than attempt to adapt the activity to a pen and paper worksheet task that might be used with a small group or the whole class. The cards provide ‘thinking space’ as students have the opportunity to move them around and see them in relation to other cards. Some tasks require the cards to be manipulated or sorted; others simply serve the purpose of presenting a problem in isolation from other problems without the expectations flagged by empty spaces to provide a whole lot of working.*

*The advice section that follows the tools for each Big Idea provides information to enable teachers to interpret student responses to each tool and plan appropriate teaching strategies. The advice is presented in a table that matches an observed response (left hand column), with an interpretation (in italics) and one or more suggested teaching responses (dot points) in the right hand column. Teachers should identify the observed response that best matches the student’s response and consider how they might implement the suggested teaching response.*

*The tools for each Big Idea have been chosen to address key concepts which, if not understood, will seriously undermine students’ capacity to engage meaningfully with core aspects of the Number Strand in subsequent years. The following table lists the Big Ideas with a brief description of each.*

Big Idea	Description
Trusting the Count	<ul style="list-style-type: none"> <li>developing flexible mental objects for the numbers 0 to 10</li> </ul>
Place value	<ul style="list-style-type: none"> <li>moving beyond counting by ones, the structure of the base 10 numeration system</li> </ul>
Additive to Multiplicative thinking	<ul style="list-style-type: none"> <li>moving from a count of equal groups (eg, 1 six, 2 sixes, 3 sixes, 4 sixes, ...) to a constant number of groups (eg, 6 ones, 6 twos, 6 threes, 6 fours, 6 fives ...), the key to understanding rational number and developing efficient mental and written computation strategies in later years</li> </ul>
Partitioning	<ul style="list-style-type: none"> <li>the missing link in building common fraction and decimal knowledge, understanding and confidence</li> </ul>
Proportional reasoning	<ul style="list-style-type: none"> <li>extending what is known about multiplication and division beyond rule-based procedures to solve problems involving fractions, decimals, per cent, ratio, rate and proportion</li> </ul>
Generalising	<ul style="list-style-type: none"> <li>skills and strategies to support equivalence, recognition of number properties and patterns, and the use of algebraic expressions</li> </ul>

*It is hoped that the tools will prove a useful resource in addressing the needs of all learners but particularly those that fall behind.*

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February 2009