CHAPTER 3

Understand Whole and Decimal Numbers

Read, write and understand the meaning, order and relative magnitudes of numbers, moving flexibly between equivalent forms.

This chapter will support teachers in developing teaching and learning programs for whole and decimal numbers that relate to this outcome:

Overall Description

Students read, write, say, interpret and use numbers in common use, including whole numbers, fractions, decimals, percentages and negative numbers.

Students can order numbers and understand the relevance of the order. For example, students know that if one collection has nine items and another has seven, they do not have to line up the items to say which collection has more. Students also know that: cordial that is one-quarter concentrate will be stronger than cordial that is one-fifth concentrate; a library book with call number 7.52 is located after a book with call number 7.513; and a temperature of –16°C is colder than –3°C.

Students understand the relative magnitudes of numbers; for example, nine is always two more than seven, '30% off' is not quite as good as 'one third off', and one million is one thousand times as big as 1000.

Students choose forms of numbers that are helpful in particular contexts. They recognise common equivalences, such as one fifth is the same as $\frac{1}{5}$, two tenths, 0.2 and 20%. Students interpret large and small numbers for which few visual or concrete references are available, and they represent them with scientific notation if appropriate. Students' number repertoire includes irrational numbers, such as 1, and those numbers that arise in practical contexts.

Levels of Achievement	Pointers Progress will be evident when students:	
Students have achieved Level 1 when they read, write and say small whole numbers, using them to say how many things there are, make collections of a given size and describe order.	• match oral names to written numbers into the teens and write recognisable versions of them • say the number names, in order, into the teens and respect the order when counting • continue the 1 to 9 pattern within a decade (e.g. 31, 32, 33); although some may need help moving, say, from 39 to 40 • say how many are in visible collections of objects; e.g. when shown six pebbles, they can answer the question 'How many are there?' • when counting small collections, use the last number said to answer the 'how many' question • make or draw collections of a given size; e.g. respond correctly to 'Give me seven bears.'	• count by adding one each time, beginning with 0 and press + 1 repeatedly on a calculator or in order to count; e.g. make a calculator that shows 5 change to 6 • understand and use 'first', 'second', etc., to indicate position in a sequence; e.g. I put the pink bear third. • sort coins and notes and realise that coins and notes have different values • give one each of a collection to a group of students, then repeat the cycle until all are distributed, and see this as 'fair shares'; e.g. distribute eight sweets among four students
Students have achieved Level 2 when they read, write, say and count with whole numbers to beyond 100, using them to compare collection sizes and describe order.	• read, write and say the numbers in order to beyond 100 and count on or back from any number to 100 • choose counting as a strategy to produce equivalent collections and to compare collections • recognise counting as a measure of set size and are convinced that they should get the same answer each time regardless of the strategy, the arrangement of the objects, or the order in which the objects are counted	• understand that you can tell from the numbers alone which collection has more • estimate the size of a collection up to 20 by mentally or visually grouping the items, or comparing it with one of a known size • count coins in multiples of 5c, 10c, 20c, 50c, $1 and $2, and record total amounts • read amounts of money and make up the amount with coins in different ways • decide whether or not they have more or less money than the price and whether to expect change
Students have achieved Level 3 when they read, write, say and count with whole numbers into the 1000s, money and familiar measurements.	• read and write any whole number into the 1000s • distinguish and order whole numbers • count up and down in 10s from any starting number • produce and use standard partitions of two- and three-digit numbers • produce non-standard partitions of two-digit numbers to assist in computation	• round numbers up or down, or to the nearest 10 or 100 • use the decimal point in representing quantities or money • regroup money to the fewest number of notes and coins • enter and read amounts of money on a calculator, truncating calculator displays to the nearest cent or unit
Students have achieved Level 4 when they read, write, say, count with and compare whole numbers into the millions and decimals (equal number of places).	• count forwards and backwards from any whole number • use place value to read, write, say and interpret large whole numbers, oral or written • understand the multiplicative nature of the relationship between places for whole numbers • say decimals correctly • use models to present decimals	• explain why money and measures use decimal notation • rewrite a decimal as a fraction • read scales including where each calibration may not be labelled • count in decimal fractions • use the symbols = , < and > to state comparisons
Students have achieved Level 5 when they read, write, say and understand the meaning order and relative magnitude of whole and decimal numbers and integers.	• understand the multiplicative relationship between decimal places • use place value to explain why one decimal fraction is bigger or smaller than another • locate whole and decimal numbers on a range of graduated scales including number lines • find a number between two decimals	• partition decimals in standard ways • use place value to partition decimals flexibly • use whole number powers and square roots in describing things • use whole negative numbers to compare and order measures • locate negative integers on a number line

Key Understandings

Teachers will need to plan learning experiences that include and develop the following Key Understandings (KU), which underpin achievement of the outcome. The learning experiences should connect to students' current knowledge and understandings rather than to their year level.

Key Understanding	Stage of Primary Schooling—Major Emphasis	KU Description	Sample Learning Activities
KU1 We can count a collection to find out how many are in it.	Beginning ✔✔✔ Middle ✔	page 12	Beginning, page 14 Middle, page 18
KU2 We can often see how many are in a collection just by looking and also by thinking of it in parts.	Beginning ✔✔✔ Middle ✔✔ Later ✔✔	page 24	Beginning, page 26 Middle, page 28 Later, page 30
KU3 We can use numbers in ways that do not refer to quantity.	Beginning ✔✔ Middle ✔ Later ✔	page 32	Beginning, page 34 Middle, page 36 Later, page 38
KU4 The whole numbers are in a particular order, and there are patterns in the way we say them which help us to remember the order.	Beginning ✔✔✔ Middle ✔✔ Later ✔✔	page 40	Beginning, page 42 Middle, page 44 Later, page 46
KU5 There are patterns in the way we write whole numbers that help us remember their order.	Beginning ✔✔ Middle ✔✔✔ Later ✔✔✔	page 52	Beginning, page 54 Middle, page 56 Later, page 58
KU6 Place value helps us to think of the same whole number in different ways and this can be useful.	Beginning ✔ Middle ✔✔ Later ✔✔✔	page 60	Beginning, page 62 Middle, page 64 Later, page 66
KU7 We can extend the patterns in the way we write whole numbers to write decimals.	Beginning ✔ Middle ✔✔ Later ✔✔✔	page 68	Beginning, page 70 Middle, page 71 Later, page 72
KU8 We can compare and order the numbers themselves.	Beginning ✔ Middle ✔✔ Later ✔✔✔	page 74	Beginning, page 76 Middle, page 78 Later, page 80

Key

✔✔✔ The development of this Key Understanding is a major focus of planned activities.

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✔ Some activities may be planned to introduce this Key Understanding, to consolidate it, or to extend its application. The idea may also arise incidentally in conversations and routines that occur in the classroom.

KEY UNDERSTANDING 1

We can count a collection to find out how many are in it.

In everyday use, 'to count' has two meanings. It can mean to recite the whole number names in their right order, beginning at 1 (*I can count to 20. One, two, three, four, ...*). It can also mean to check a collection one by one in order to say how many are in it (*I counted and found there were 14 left*). Key Understanding 1 focuses on the latter meaning. The former meaning is an aspect of Key Understanding 4.

The significance of counting is that it enables us to decide how many are in a collection or to make a collection of a given size. However, we can sometimes 'see' how many without actually counting. To be able 'to count' a collection of things, a student must remember the number names in the right order and be able to use them to decide 'how many'. Students will learn to do this in different ways and in different orders, so different sequences and types of learning activities may be needed. The Sample Learning Activities for Key Understanding 1 should help students link the order in which we say the number names with the size of collections.

Students need to internalise the following five principles for counting a collection if they are to fully accept that counting 'works' and so students must always give the same answer each time.

- Each object to be counted must be touched or 'included' exactly once as the numbers are said.
- The numbers must be said once and always in the conventional order.
- The objects can be touched in any order, and the starting point and order in which the objects are counted does not affect how many there are.
- The arrangement of the objects does not affect how many there are.
- The last number said tells 'how many' in the whole collection. It does not describe the last object touched.

Students who have achieved Level 1 of the outcome for Understand Numbers understand what it is that they have to do in response to questions or requests, such as: How many dogs are there? Give me seven forks. Students will match the numbers in order as they point to or look at each object exactly once. They know the last number said answers the 'how many' question.

However, many students do not fully understand the five principles listed on the opposite page and so may still think that if they start in a different place, they could get a different answer. They may not fully trust the count and may not choose to count. Thus, students who can count, when they are asked to find 'how many', or if the word 'count' is mentioned, may not trust it to help them decide, for example, if there are enough drinks for other students. They may simply hand out the drinks or put a name to each drink, or guess. Students need to learn to trust the count and, without prompting, to choose 'counting' as a way of solving such problems. Experience with problem situations in which students are not always told to count or to find how many, should help them move from the Counting phase through to the Quantifying phase.

Students who have achieved Level 2 do trust and use counting for themselves. They know that any collection has only one 'count'. They would laugh at the idea that a collection could have both 26 and 27 objects. To them, it is obvious that you can tell from the numbers alone which collection is bigger, that a collection of 27 objects always has one more than a collection of 26. Until students realise this, they cannot fully understand numbers as abstractions with properties of their own such as 27 is greater than 26.

Students need to learn to use equal groupings or parts to help count large collections. Students who only learn to skip count by reciting every second or every third number, or by jumping along a number line saying, 2, 4, 6, 8, and so on, may not realise that skip counting also tells you 'how many'. These students will need a lot of practical experience in order to see that pulling out three at a time and counting by threes gives the same answer as if they had counted by ones.

Trusting that all the different ways of counting must give the same number is the key to advancing from Level 1 to Level 2 of the mathematics outcome.

SAMPLE LEARNING ACTIVITIES

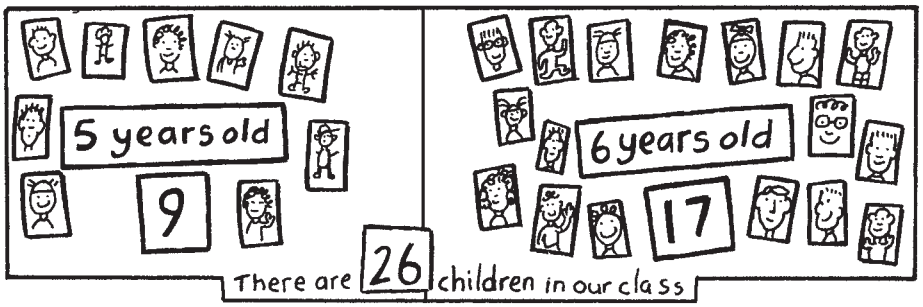
Beginning ✔✔✔

Birthday Claps

Ask students to clap once for each birthday they have had. Have students link each clap with each number name as it is said.

Age Groups

Make a classroom display of students' names (photos). Arrange the names (photos) according to age groups. Have students count how many are in each group and then write number labels for the groups (e.g. *8 students are 4 years old. 15 students are 5 years old.*) As each student has a birthday, ask the student to move his or her name (photo) across to the appropriate age group. Invite all students to count how many in each group now. Ask: Which group must get smaller (bigger)?



Teeth

Vary the 'Birthdays' activity by asking students to count how many in the class have (have not) lost teeth. (See Sample Lesson 1, page 20.)

Collections

Have students make collections of a given number of things for real tasks; for example, have them choose six beads to make a necklace.

How Many?

Ask students to read number labels on storage containers to see how many things they have to get. Label shelves to show how many blocks of each type there are in the containers. During 'packing away time', ask students: How many blocks have you returned so far? How many more do we need to find?

Keeping Fit

Have students decide each day (week) how many jumps and hops to include in their daily fitness routine and then record the number. Ask students to decide whether they need more or less of each action and to record this new number. Ask: How many jumps (hops) will we have today (this week)?

Labelling Collections

Invite students to count and write number labels for collections they have sorted and graphed, such as shells, into categories of their own choosing. Have them show how they know there are more in one group than another. Ask: How do you know eight is more than seven? Would eight elephants be more than seven elephants?

Counting Cakes

Have students count a line of objects (e.g. play dough 'cakes'). Ask: Will there be the same number of cakes if we start counting from the other end? Why? Why not? Count the objects again but, this time, start with the middle object. If a student can't do this, repeat with three objects and increase the quantity by one each time. Ask: What did you do to count all the cakes? Does it matter where you begin?

Number Trains

Have students practise the number sequence when lined up (e.g. to enter or leave the classroom). Ask each student to count in turn from one to determine 'how many' students are in the line. Ask: Could we find out how many are here if we count by 2s? Will we get the same number?

Biggest Number

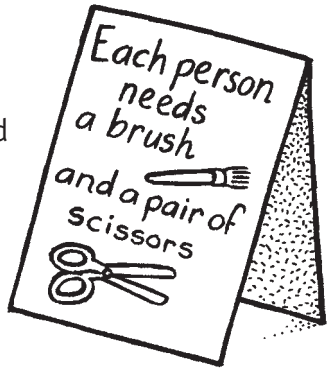
Ask students to choose and use materials to show why seven is less than eight when counting a collection. Focus on the idea that the next number names a quantity which must always be one more than the number before.

Grouping

Invite students to rearrange a collection of things to make them easier to count (e.g. counting to see how many students are at school today). Ask: Can we arrange ourselves so it is easy to count? Is there another way? Record the totals each time, then ask: What do you notice about how many we get every time we count? Why don't we get a different number if we start with a different person?

Choosing Equipment

Ask students to set out equipment for an activity (e.g. art activity) by referring to the number of students and collecting enough equipment for each. To begin, place one chair for each student at a table, then stand a sign on the table saying what equipment is needed (e.g. paintbrush, scissors).



Different Totals

When the class is counting a collection and some students arrive at different totals for the same amount, have students consider whether or not this is possible. Ask: Could we all be right? Why? Why not?