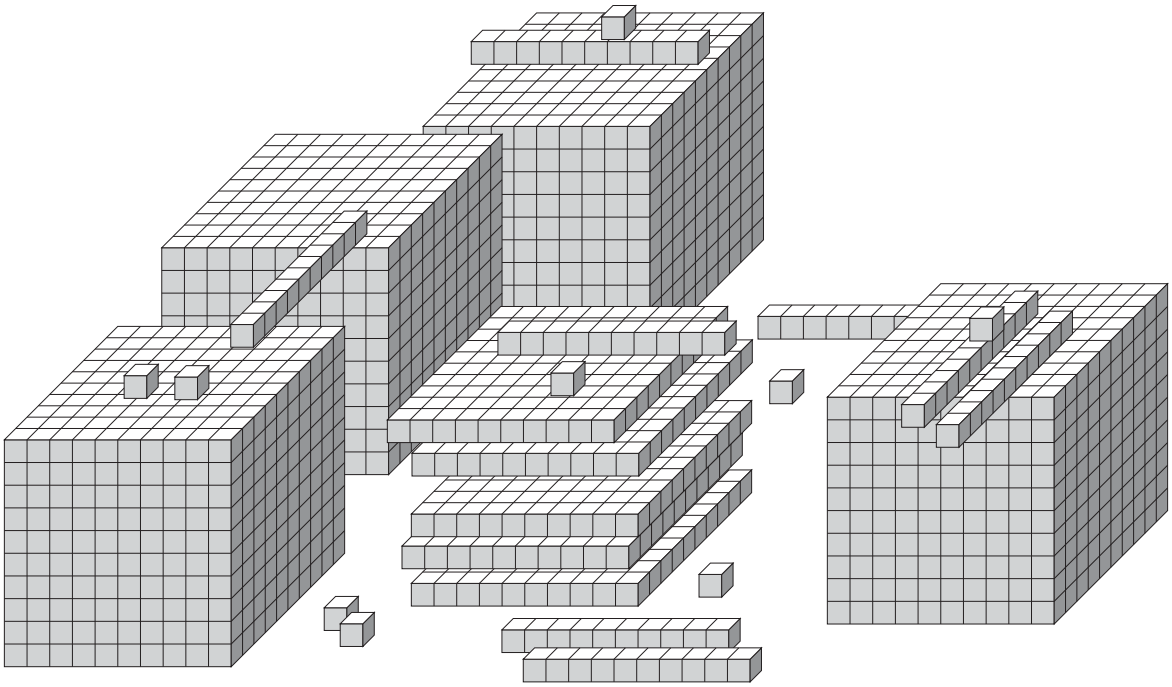
The Place Value Book

A Workbook for all Primary / Elementary Grades

MANUAL



by

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The Place Value Book Manual

Contents - Concept List

	Page
INTRODUCTION	3
MATHEMATICS	
EARLY NUMBER	
• Auditory Discrimination	3
• Auditory Memory	3
• Conservation of Number	4
• Counting by Ones	4
• Fine Motor Skills	4
• Hand/Eye Coordination	4
• One to One Correspondence	4
• Ordering	4
• Pattern & Repetition	5
• Sorting & Classifying	5
• Visual Copying	5
• Visual Discrimination	5
• Visual Memory	5
• Vocabulary	6
NUMBER / NUMERATION	
• Analysing Numbers	6
• Arrays	6
• Contracting Numbers	6
• Comparing Numbers	6
• Converting Concrete into Abstract	7
• Counting Forwards and Backwards	7
• Estimation	7
• Expanding Numbers	8
• Factors	8
• Index Notation - Indices	8
• Largest and Smallest Numbers from Digits	8
• Negative Numbers	8
• Number Facts	8
• Number Lines	9
• Number Sentences	9
• Odd & Even Numbers	9
• Ordering Numbers	9
• Place Value	10
• Prime & Composite Numbers	10
• Reading Numbers	10
• Rounding Numbers	10
• Sequences	10

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- Square Numbers 11
- Tests of Divisibility 11
- Triangular Numbers 11
- Unnecessary Zeros 12
- Writing Numbers 12
- Zero as a Placeholder 12

OPERATIONS
- Addition 12
- Division 13
- Multiplication 13
- Subtraction 13

PROBLEM SOLVING
- Averages 13

RATIONAL NUMBERS
- Fractions 13
- Decimals 14
- Percentages 14
- Ratio 14

MEASUREMENT
- Area 14
- Capacity 15
- Length 15
- Mass 15
- Money 15
- Perimeter 16
- Temperature 16
- Time 16
- Volume 16

SHAPES / GEOMETRY
- Angles 17
- Plane Shapes 17
- Solid Shapes 17
- Symmetry – Mirror & Rotational 18

STATISTICS / GRAPHS / DATA
- Frequency Polygons 18
- Line Graphs 18
- Picture Graphs 18
- Probability - Chance 18
- Tallying 19

LANGUAGE

- Creative Writing 19
- Instructional Writing 19
- Speaking & Listening 20

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INTRODUCTION

I have tried to cover as many concepts as possible, but the exercises and activities are not exhaustive, they are just starting points. In reality, there would be hundreds of thousands of individual activities and exercises that teachers and homeschoolers could devise for their students. The exercises I have suggested may have to be altered to suit the ability of students. The Numerical Summary on page 21 will help in devising suitable exercises and activities.

Helpful resources to use with The Place Value Book are the wooden or plastic blocks that represent ones, tens, hundreds and thousands. In some countries, these 'concrete' teaching aids, or manipulatives, are called 'Place Value Blocks', in others 'MAB Blocks'. In this manual, I have used the initials PVB/MAB to refer to these.

MATHEMATICS

EARLY NUMBER

Auditory Discrimination

When students are listening to instructions and carrying out the directions, they are using auditory discrimination. They are determining the meaning of words by comparing them with similar sounding words they already know. Sometimes they don't listen carefully enough, and errors occur.

Use similar sounding words in giving instructions and observe the students' responses, e.g. top, stop; five, nine; best, left; more, draw; even, seven, eleven; take, eight, etc.

"A tap on the desk means a ten, a tap on this glass means a one. Close your eyes while I tap, then choose the correct frame on page 5. (Bock…bock…ting…ting…ting)." (5C [23])

Auditory Memory

"After I count to three find the frame on page 4 that has four tens and seven ones. One…two…three." (4D [47]) Do not repeat the instruction. Those students who forget can try the next time.

"After I count to three I want you to turn to page 3 and point to the tallest shape. One…two…three." (3G)

Vary the number of steps in each command to meet the level of students. Begin with exercises that they are likely to get right, e.g. "After I count to three, point to a ten. One…two…three."

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Conservation of Number

Students have some PVB/MAB from which to choose.

"Get the same number of ones you see in frame 2A [7]. Count them to make sure you have the same number. Now see how many different ways you can arrange the ones. Count them each time to make sure you still have the same number."

Counting by Ones

"Count aloud the little blocks in 1B [9]. Point to them as you count." (Student, "One, two, three, four, five, six, seven, eight, nine.")

"Count in your head the little blocks in 2D [8] and put your hand up when you know how many there are." (8)

Fine Motor Skills

Students develop fine motor skills when colouring. They can colour the blocks in different colours to differentiate between ones, tens and hundreds. I suggest colouring brown for thousands, red for hundreds, orange for tens and yellow for ones. The colours are of the same hue and grade in intensity from right to left, just like the numbers in place value. These colours match the colours used in the Number Crunchers, another invaluable manipulative that addresses place value and many other mathematics concepts.

When students copy even the simplest frames using PVB/MAB, they are using fine motor skills.

Hand/Eye Coordination

This skill is developed in colouring and manipulating small items. See exercises under Fine Motor Skills above.

One to One Correspondence

When students reproduce with PVB/MAB the figure in a frame, they will automatically practice one to one correspondence, or 'matching'.

Ordering

Pages from the book can be photocopied and cut into frames. Students can order them according to the number represented.

"Which frame on page 4 has the largest number?" (4H [92])

"Which frame on page 3 has the smallest number?" (3D [10])

"Order the frames on page 3 from smallest to largest." (3D, 3A, 3E, 3G, 3B, 3H, 3C, 3F)

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Pattern & Repetition

The blocks in some frames are arranged in patterns. In 6B the pattern is vertical, and students could be asked to continue the pattern with PVB/MAB. Another example is 15E.

With PVB/MAB, students can match a frame and then arrange them in some form of a pattern. Students should select frames where the blocks could form a pattern.

Many frames could form the first part of a pattern, e.g. 5B, 6F, 8G, 8H, 9F, 10A and 10D. Students can select a frame, copy it with PVB/MAB and continue the pattern.

Sorting & Classifying

Pages from the book can be photocopied and cut into frames. Students are then able to sort and classify them according to specific attributes.

Some examples of specific attributes of frames are numbers less than ten; numbers greater than 500; numbers needing zeros as placeholders; blocks in place value order or random; arrangements of blocks that are symmetrical in some way; blocks that are neat or untidy; frames where all blocks are no higher than a small block.

Visual Copying

Using PVB/MAB students copy, as accurately as they can, a particular frame.

Visual Discrimination

When ordering, sorting, classifying or comparing frames students use visual discrimination skills.

Students look for the similarities and differences when comparing frames. When introducing a concept, always keep it simple.

"What is the same about 1G [8] and 2D [8]?" (They have the same number of ones)

"What is different about 1C [5] and 1G [8]?" (1C shows the ones in a row; 1C has fewer ones; 1G has more ones.)

Visual Memory

Students are allowed to examine a particular frame for a limited time (5 seconds, 10 seconds). When the time has expired, students are to turn the page over and reproduce the frame using PVB/MAB.

Again, after the time has expired, questions about the frame are put to the students: "Did the frame have any tens? Were the blocks in place value order? How many ones were there? What number does it represent? How many more ones would I need to make another ten?"

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Vocabulary

While giving instructions to students teachers and homeschoolers can incorporate appropriate vocabulary necessary for students to master: smaller than, larger than, on top of, below, beside, on the right, on the left, straight, pattern, longer than, shorter than, taller than, equal to, order, half, most, more, add, take away, lots of etc.

NUMBER / NUMERATION

Analysing Numbers

This analysis of 11B [278] is not exhaustive. Each of the following expressions is equal to 278: 200 + 78; 270 + 8; 200 + 70 + 8; (2 x 139) + 8; 500 – 300 + 78; (2 x 130) + (9 x 2); (2 x 100) + (7 x 10) + (8 x 1); (10 x 25) + 28; (50 x 5) + (2 x 11) + 6; etc.

Arrays

Arrays are objects arranged in rows, and columns, such as you would find in chocolate bars or capsule blister packets. A 3 x 5 array has three rows of five or five rows of three depending on how you look at it. The hundred block is a 10 x 10 array.

Once students recognise arrays, they can search for them in the book.

"What arrays can you find on page 8? Write the frame and the size of the array." (8B, 3 x 10; 8C, 6 x 10; 8F, 8 x 10; 8H, 6 x 10)

"What number facts can you see in the 3 x 10 array in 13F?" (3 x 10 = 30; 10 x 3 = 30; 30 ÷ 3 = 10; 30 ÷ 10 = 3; 1/3 x 30 = 10; 1/10 x 30 = 3; 4/10 x 30 = 12 etc.)

Contracting Numbers

Teachers give students the expanded form of the number represented by a frame. Students contract the number and find the frame on a given page or pages.

"Which frame on page 14 is equal to: 50 + 9 + 200?" (14H [259])

"Which frame on pages 11 to 13 is equal to: $(7 \times 10^2) + (5 \times 10^1) + (1 \times 10^0)$?" (13D [751])

Comparing Numbers

"Using page 15 write the numbers of the frames in order from smallest to largest." (15H [5], 15B [15], 15C [96], 15E [350], 15F [902], 15A [1,096], 15G [1,140], 15D [2,503])

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"What is the same about the numbers in frames 5A [36] and 2E [16]?" (Both are square numbers, both are even numbers, both are divisible by two and four)

"Which is the largest number represented on page 17?" (4,085 [17E])

"Write the numbers on pages 9 to 11 inclusive, that are divisible by five." (70 [9F], 600 [9H], 800 [10C], 85 [10E], 500 [11D], 740 [11E)

Converting Concrete into Abstract

Students need to be able to write a number in abstract or digital form (1, 2, 3, etc.) when the number is shown using practical or concrete aids such as counters, PVB/MAB or an abacus.

When students determine the number represented by a frame they are converting concrete into the abstract. Each time they do this they write the digital (abstract) number for the frame in the small oblong in the top right-hand corner of the frame: writing the number makes subsequent exercises more efficient. Writing numbers in pencil makes corrections easier.

The Place Value Number Cruncher is ideal for tallying PVB/MAB and writing the number in the frames. This Number Cruncher gives an automatic and dynamic link between concrete and abstract number. These unique and significant resources will be a future addition to the resources in betterhomesandschools.com.

Counting Forwards and Backwards

For counting the number represented by a frame is used as a starting point for counting forwards and backwards. Counting can be by: 1, 10, 100, 5, 25, 50, 200, 3, 1000, 1500, 250, 500 etc.

Counting forwards by 1's from frame 1B [9]: "Nine…ten…eleven…twelve …"

Counting forwards by 25's from frame 11D [500]: "Five hundred…five hundred and twenty-five…five hundred and fifty…"

Counting backwards by 20's from 11C [112]: "One hundred and twelve…ninety-two…seventy-two…fifty-two…"

Estimation

Without counting, students are asked to estimate the number represented by a frame, or the total of a number of frames.

After estimating totals students should then determine the exact sum and compare it with their estimates.

Various strategies for estimating should be explained and practised.

"Estimate how much I would need to add to frame 10D [362] to make 500." (about 150)

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"Estimate as quickly as you can the sum of all the frames on page 7." (about 500)

Expanding Numbers

"Expand the number represented by 9C [576]." (500 + 70 + 6)

"Write in expanded form the number represented by 15D [2,503]." (2000 + 500 + 3)

"Expand, using index notation, the number represented by 17B [2,157]." $(2 \times 10^3) + (1 \times 10^2) + (5 \times 10^1) + (7 \times 10^0)$

Factors

"Write all the factors of the number represented in 7C (32)." (1, 2, 4, 8, 16, 32)

"What frame would represent a number that has only two factors?" (4B [17], 2A [5], 5H [31], … any prime number)

Index Notation - Indices

"Expand 9C [576] and write it using index notation." $(5 \times 10^2) + (7 \times 10^1) + (6 \times 10^0)$

"Use indices to write the number represented in 6B [27]." (3^3)

Largest and Smallest Numbers from Digits

Students need to be able to make the largest or smallest number from two, three, four or more digits, e.g. the largest number that a person can make from the digits 3, 5 and 1 is 531.

"Which frame on page 6 displays the smallest number that can be made from the digits 8 and 3? (6D [38])

"Find the frame that represents the largest number you can make from the digits 4, 8 and 1." (11H [841])

Negative numbers

"Take 10C [800] from 10D [362] and show your result on a number line." (The result would be –438)

"Add the two results of taking 4C [88] from 4E [65], and 5B [29] from 5C [23]. Show your working." (65 – 88 = -23; 23 – 29 = -6; -23 + -6 = -29)

Number Facts

There are many ways you can consolidate number facts.

"Find numbers or digits within numbers to make all the multiples of three

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from 0 to 36. Write the numbers of the frames where you find the numbers." (3 [1D]; 6 [2B]; 9 [1B]; 12 [3A]; 15 [3B]; 18 [2G]; 21 [17B]; 24 [19B]; 27 [6B]; 30[6A];33 [13F]; 36 [5A])

"To which multiplication tables do the numbers on page 3 belong?" (3A [12] 2, 3, 4, 6,); (3B [15] 3, 5); (3C [17] none); (3D [10] 2, 5, 10) etc.

Number Lines

Students can use number lines, of an appropriate scale, to represent suggested frames.

"Draw a number line of appropriate scale and mark on it the numbers represented in the top four frames of page 13."

"On the number line I have given you, mark all the numbers represented on page 2."

Number Sentences

Write number sentences that contain the number represented in 6C [42]." (6 x 7 = 42); 42 ÷ 7 = 6; 50 – 8 = 42; (2 x 3) x 7 = 42; etc.

"Using only the numbers represented on page 1 write five number sentences without using any digit more than once in a number sentence." (4 + 3 = 7; 8 – 5 = 3; 9 – (3 + 1) = 5; 2 x 4 = 8; 5 + 8 – 4 = 9)

Odd & Even Numbers

"How many odd numbers are found on page 2?" (3)

"Find two odd numbers on page 1 and add them together. Is your answer odd or even?" (even)

"Add an odd and even number represented on page 3. Is your answer odd or even?" (odd) "Try other pairs of odd and even numbers to see if the sum is always odd."

Ordering Numbers

Pages may be photocopied, and individual frames cut out so students can order them from smallest to largest or from largest to smallest.

"Write in order, from smallest to largest, the numbers of the frames on page 11." (11C [112]; 11B [278]; 11G [353]; 11E [470]; 11D [500]; 11F [516]; 11A [709]; 11H [841])

"Write the numbers represented by the frames on page 17 in order from largest to smallest." (4,085 [17E]; 3,902 [17F]; 2,157 [17B]; 1,596 [17C]; 1,154 [17A]; 1,008 [17D])

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Place Value

The PVB/MAB in some frames are arranged in place value order, some are not, e.g. consider 4G, 11H, 12F, 13D, 13F.

"Which frames on page 14 are arranged in place value order?" (14A, 14D and 14G)

"Using PVB/MAB, copy 11B as accurately as you can. Now rearrange them in place value order."

"Draw an arrow on 11H to show the direction you would have to look for blocks to be in place value order."

"What would you have to do to 13E to have the blocks in place value order?"

Prime & Composite Numbers

"Using the counters in front of you, find out which numbers represented on page 3 can make an array. Those that can (3A [12], 3B [15], 3D [10], 3G [14] and 3H [16]) are composite numbers, the rest are prime numbers."

"If prime numbers have two factors, one and the number itself, find the prime numbers represented on page 4." (4B [17] and 4D [47])

Reading Numbers

Reading numbers directly from frames is a good place value exercise. Some frames are more difficult than others.

"Read the number represented by 13F [333]." ("Three hundred and thirty-three.")

"Read the number represented by 13C [177]." (One hundred and seventy-seven.")

Rounding Numbers

"Round 3F [19] to the nearest ten." (20)

"Round 9E [711] to the nearest hundred." (700)

"Round 17B [2,157] to the nearest hundred." (2,200)

"Round 16B [265] to the nearest ten." (270)

Sequences

"Using three numbers from page 1 devise a sequence and continue it two more steps." (5, 7, 9, … 11, 13; 1, 2, 4, … 7, 11; 1, 4, 9, … 16, 25)

"Using frames from anywhere in the book devise a four-step sequence but only write the number of the frame. Give the start of the sequence to another student who will then work out the numbers in the sequence and continue it three more steps."

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(1C [5], 3D [10], 7A [20], 4A [35] … 55, 80, 110)

Square Numbers

"How many square numbers can you find in the book?"

"Can you find a square number represented on page 14?" (14D [400] =20 x 20)

Tests of Divisibility

Students can test numbers in the frames according to test rules.

All numbers are divisible by one.

All even numbers are divisible by 2.

Add the digits of the number, if the number you get is divisible by three then so is the original number. Keep adding the digits for larger numbers, e.g. for the large number 921,357,018 add the digits (36), add the digits again (9).

If you can halve the number twice and still have a whole number, the number is divisible by 4.

If the number ends in a 0 or 5 the number is divisible by 5.

If the number is divisible by 2 and 3 (factors of 6) the number is divisible by 6.

There is no test for 7. You just have to do it the hard way.

If you can halve a number three times and still have a whole number the number is divisible by 8.

If you keep adding the digits of a number and your result is a multiple of 9 then the number is divisible by 9.

Numbers that end in 0 are divisible by 10.

"Find the numbers represented on page 9 that are divisible by 9." (9C [576] and 9E [711])

Triangular Numbers

Triangular numbers build up triangles 1, 3, 6, 10, 15 etc.

"Can you see the triangle of three ones in 2B? Starting with the top layer (1), when we continue to add layers beneath, the result is a sequence of triangular numbers, 1, 3, 6 ... 10, 15.

"Which frame on page 2 has a larger triangular number?" (2B [6]) "Continue the sequence two more steps with real PVB/MAB and write the sequence of triangular numbers." (1, 3, 6, 10, 15)

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"Can you find any three digit triangular numbers in the book?"

"Can you find the triangular numbers in 3C, 4D, 10A and 13A?"

Unnecessary Zeros

Students need to be aware of the necessity to eliminate unnecessary zeros e.g. if I divide 18B [4,000] by 100, the answer is 40, not 40.0 or 40.00.

The elimination of unnecessary zeros at the left end of numbers is also necessary, e.g. the difference after subtracting 14D [400] from 11E [470] is 70 not 070.

"Divide 9H [600] by one hundred and write your answer." (6)

Writing Numbers

Students need practice in writing numbers in digits and words.

"Write using digits the number represented by 10F [507]." (507)

"Write using index notation the number represented by 14F [617]. $((6 \times 10^2) + (1 \times 10^1) + (7 \times 10^0))$

"Write in words the number represented by 13H [648)]." (Six hundred and forty-eight)

Zero as a Place Holder

"Which frames on page 6 need zeros as placeholders when writing the number in digits?" (6A [30] and 6E [50])

"Which frame on pages 16 to 20 needs the most zeros as placeholders when writing the number in digits?" (18B [4,000])

OPERATIONS

To reinforce place value teachers might want to set operation exercises in an informal algebraic form such as 3E + 2G, 8E - 6B, 5E x 1C, 9B ÷ 2H.

The degrees of difficulty are varied by selecting frames appropriate to the ability of the students.

Addition

"Find the sum of 1A [7] and 2D [8]." (15)

"Find the sum of 13A [289], 14H [259], 17B [2,157] and 19B [4,324]." (7,029)

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Division

" Find the quotient when 2E [16] is divided by 1E [4]." (4)

"Find the quotient when 17C [1,596] is divided by 8H [61]." (26.16)

Multiplication

"Find the product of 1H [2] and 2B [6]." (12)

"Find the product of 8C [63] and 15D [2,503]." (167,689)

Subtraction

" Find the difference between 2G [18] and 3H [16]." (2)

"Find the difference between 17C [1,596] and 18A [3,099]." (1,503)

PROBLEM SOLVING

A variety of problems, dealing with different concepts and varying degrees of difficulty, can be devised by parents and teachers. Begin with the concept, e.g. money, then decide on the degree of difficulty and use appropriate frames to suit.

"If I had to buy some blocks (PVB/MAB) and it cost $2.30 for a hundred block, $0.65 for a Tens block and $0.02 for a one block, how much would it cost me to buy the blocks shown in 10D [362]? "

Averages

"Calculate the average number of ones in the frames on page 1." (4 r7 or 4.875)

"Calculate the average number of tens in the frames on pages 5 to 7." (4 r9 or 4.375)

"In estimating the average of the numbers in the frames of page 16, is the average going to be over 500 or under 400?" (Over 500)

RATIONAL NUMBERS

Fractions, decimals and percentages involve the concept of ratio. A couple of examples will suffice to demonstrate how the Place Value Book can be used to address these concepts.

Fractions

"What fraction of all the blocks in 5E [44] are ones?" (4/8 or 1/2)

"What fraction of all the blocks in 6C [42] are tens? (4/6 or 1/3)

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"What fraction of all the blocks smaller than hundreds in 13H [648] are tens." (4/12 or 1/3)

Decimals

"What decimal of all the blocks in 7G [99] are tens?" (0.5)

"What decimal of all the blocks in 15D [2,503] are ones?" (0.3)

"What decimal of all the blocks in 9D [31] are resting on other blocks?" (0.25)

Percentages

"Of the blocks in 11C [70] what percentage are resting on other blocks?" (75%)

"Of the blocks in 12A [631] what percentage are hundreds?" (60%)

"Of all the blocks in 6C [42], 7A [20], 5A [36] and 1H [2] what percentage are ones.?"(16%)

Ratio

"What is the ratio of hundreds to ones in 11B [438]?" (4:8 or 1:2)

"What is the ratio of hundreds to ones to tens in 18F [278]?" (2:8:7)

"On page 9, what is the ratio of frames that have no ones to frames that do?" (2:6 or 1:3)

MEASUREMENT

Educators from countries that use different measures such as inches instead of centimetres will need to make different assumptions for their students.

For using The Place Value Book for measurement activities assume the following:

- That all blocks are based on the one cubic centimetre (1 cm^3).
- That if the blocks were water, 1 cm^3 would have a capacity of 1 millilitre (1 mL).
- That if the blocks were water, 1 cm^3 would have a mass of 1 gram (1 g).

Area

"What would be the upper surface area of the shape in 16C [171]?" (171 cm^2)

"What is the total surface (outside) area of the 3D shape in 4A [35]?" (138 cm^2)

"What is the total surface (outside) area of the 3D shape in 11A [709]?" (486 cm^2)

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Capacity

Students need to understand that one cubic centimetre (1 cm^3) of water is equal to one millilitre (1 mL). For these exercises, students need to assume that all blocks are hollow and filled with water.

" How much water would be represented by 9D [31]?" (31 mL)

" How much water would be represented by 18A [3,099]?" (3,099 mL or 3 L 99 mL)

" How much water would be represented altogether by 9D [31]?" (2,503 cm^3)

Length

When it is appropriate, include both external and internal edges in calculations.

"What is the total length of all the edges in 1H [2]?" (12 cm)

"What is the total length of all the edges in 2E [16]?" (84 cm)

"What is the total length of all the edges in 4F [58] minus all the edges in 5C [23]?" (280 cm - 108 cm = 172 cm)

Mass

Students need to assume the mass of one cubic centimetre (1 cm^3) has the mass of one gram (1 g). They would have a mass of 1 cm^3 if they were made of water.

"Calculate the mass of 3C [17]." (17 g)

"Calculate the mass of 15G [1,140]." (1,140 g or 1 kg 140 g)

"Calculate the total mass of 8E [75], 15D [2,503] and (17C [1,596]." (4,174 g or 4 kg 174 g)

Money

For these exercises have students assume the value of one cubic centimetre is $0.01. In the younger grades, it would be helpful to retain this value as it helps them develop a quantitative understanding of money.

Using play money, or real money, have students make up the value of selected frames.

"Calculate the value of 3A [12]." ($0.12)

"Calculate the value of 12D [275]." ($2.75)

"Calculate the total value of 16G [2,039] plus 17F[3,902]." ($20.39 + $39.02 = $59.41)

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Perimeter

For these exercised students need to understand that perimeter means the top, outside edges of the shape.

"Calculate the perimeter of the shape in 8F [80]." (36 cm)

"Calculate the total perimeter of the shapes in 10B [66]." (34 cm)

"Calculate the total perimeter of the shapes in 2D [8], 4D [47] and 16C [171]." (32 cm + 88 cm + 52 cm = 172 cm)

Temperature

For these exercises, students need to understand that the number represented in a frame represents the number of degrees Celsius, daylight temperature. Teachers, parents and homeschoolers who use Fahrenheit would use different frames. Students are asked to choose between the following to rate the frame: very cold, cold, pleasant, hot and very hot. Alternately the choices could be limited to cold, pleasant and hot.

"Rate the temperature represented in 3A [12]." (12° C - Cold)

"Rate the temperature represented in 5E [44]." (44°C - Very hot)

"Select a frame on page 5 that you would rate the temperature as pleasant." (5C [23] - 23°)

Time

Enterprising teachers and parents could devise problem questions that deal with different elements of time, e.g. seconds, minutes, hours etc. Subjects for time problems could be: a dripping tap filling shapes, cutting crystal cubes, cutting blocks of sandstone, growing cube shaped berries (children like ridiculous problems :), cube-shaped hailstones or making cubes of cheese. (I was about to suggest cube shaped hens' eggs but I would have the animal rights people on my neck.)

"Pretend the small blocks represent cement building blocks. How long would it take to construct the structure in 10D [362] if it takes an average of two minutes to lay one block?" (722 minutes = 12 hr 2 min)

Volume

" What is the total volume of all the blocks in 1G [8]?" (8 cm^3)

"What is the total volume of all the blocks in 13H [648]?" (648 cm^3)

"What is the total volume of all the blocks in 4H [92] and15D [2,503]. (2,595 cm^3)

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SHAPES / GEOMETRY

Angles

Students need to see the figures in the frames as two dimensional, not three dimensional.

"Can you find a shape in 8D that has three right-angles, one acute angle and one reflex angle?"

"How many acute angles can you see in 2C?" (10)

"How many obtuse angles can you see in 4B?" (34)

"How many right-angles can you see in 3B?" (27)

Plane Shapes

For the exercises below students at times will need to assume they are looking at real PVB/MAB (three dimensional) and that all surfaces of the cubes have four right-angles. At other times students will have to look at the shapes in the frames as they appear (two dimensional). For example, the 'cube' in 1F is made up of one square and two rhombuses.

"Assuming the blocks are three dimensional, how many right-angles would there be altogether in the block in 1F?" (24)

"Assuming the figures in the frames are two dimensional, how many rhombuses can you see in 1D?" (6)

"Assuming the figures in the frames are two dimensional, can you find the octagon in 1B?" (The face of the 'block' highest in the frame.)

Invite the students to list all the plane geometric shapes and find at least one frame where the shapes are found. I have been able to find polygons from three to eight sides, i.e. triangles, squares, rectangles, oblongs, rhombuses, parallelograms, quadrilaterals, pentagons, hexagons, heptagons and octagons.

"Assuming the figures in the frames are three dimensional, and all the shapes are made up of individual 'ones' (small cubes), how many squares would there be altogether in 17E [4,085]?" (24, 510)

Solid Shapes

When using the book to teach solid, (3D) shapes, of necessity students need to assume the figures in the frames are three dimensional.

The solid shapes that can be seen in the figures are cubes, square prisms and rectangular prisms.

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Symmetry – Mirror & Rotational

Again students need to assume the figures are three dimensional.

"Find a frame on page 4 that has mirror symmetry." (4A)

"What four frames on page 5 have figures that have mirror symmetry?" (5B, 5C, 5F and 5G)

"What frame on page 1A has a figure that has four-fold rotational symmetry?" (1F)

"Does the figure in 6H have mirror symmetry?" (No)

"What frames on page 10 have figures that have rotational symmetry?" (10A, 10C, 10D and 10E)

"Which frames on page 18 have figures that have mirror symmetry?" (18B, 18C, 18D and 18F)

STATISTICS / GRAPHS / DATA

Frequency Polygons

"Tally the thousands, hundreds, tens and ones on page 18 and construct a frequency polygon."

"Construct a frequency polygon for the digits zero to 9 for the numbers representing the figures on pages 14 and 15."

Line Graphs

"Tally the thousands, hundreds, tens and ones on page 18 and construct a line graph."

"Order the numbers on page 13 and, choosing an appropriate scale, construct a line graph of the ordered numbers from smallest to largest."

Picture Graphs

"Construct a picture graph of the hundreds, tens and ones blocks found on page 9."

"Construct a picture graph of the digits 0 to 9 found in the numbers that represent the figures on page 10."

Probability - Chance

For these exercises, students imagine that for each hundred block they have a counter on which 100 is written, for each ten block they have a counter on which 10 is written and for each one block they have a counter on which 1 is written.

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Students will imagine putting counters representing a particular frame, in an opaque, cloth bag and asking an imaginary student to close their eyes and select a counter.

If the frame 9B[256] is chosen, students should imagine putting in a bag, two counters on which 100 is written, five counters on which 10 is written and six counters on which 1 is written.

"On page 2, which frame's counters would you put in a bag so that the student would have an equal chance of selecting a 'ten' and a 'one'?" (2F [11]).

"On page 2, which frame's counters could you put in a bag so it would be impossible for the student to pick a 'ten'?" (2A[5], 2B[6], 2C[0] or 2D[8])

"On page 5, which frame's counters would you put in a bag so that the student would be unlikely to select a 'one'?" (5H).

"On page 10, which frame would you select where the student would be more likely to select a 'ten' than a 'hundred', but less likely to select 'one' than a 'ten'?" (10D[362])

"On page 7, which frame would you select where the student would have a 60% (or 0.6) chance of selecting a 'one'?" (7E[46])

Here is a list of terms you can use in teaching probability: likely, unlikely, impossible, chance, equal chance, good chance. Also incorporate fractions, ratios, percentages and decimals to describe chance.

Tallying

"Tally all the 'ones' on 1A [7], 1B [9], 1C [5] and 1D [3]." (𝍸 𝍸 𝍸 𝍸 llll)

LANGUAGE

Creative Writing

Use frames as a visual starting point for students to write stories.

15C "I knew I had to reach the highest point if I was to survive
13A "We had only begun excavating the steps of an ancient Aztec pyramid when the hairs on the back of my neck bristled."
13C "I was staggered at the devastation. Did Jenny get out on time?"
7G "A covered truck. Mysterious, midnight deliveries to an abandoned warehouse. I knew I had to investigate."
18E "I knew there was more to the unusual, rooftop connections than met the eye."

Instructional Writing

"Choose a frame, then write directions for another student to reproduce the figure using PVB/MANB." Together the students compare the instructions with the completed figure and make amendments where necessary.

"Write instructions for constructing 6B."

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"Compare and contrast 10A and 10B."

"Describe 6F."

Speaking & Listening

Two students face away from each other; one has a page from The Place Value Book, the other has some PVB/MAB. Neither student is allowed to turn around. The student with the page selects a frame and gives accurate instructions to the other student so that student can reproduce the figure in the frame. On completion, both students compare the results. The student giving the instructions must speak clearly and loud enough for the other student to hear. Instructions are not to be repeated.

"After I give the instructions and count to three, I want you to find the number of the frame. Go to page 2. From 2G go up two frames. One...two...three." (2C)

"After I give the instructions and count to three you may begin to search. Find the first page that contains at least one thousand block. Start and the bottom right-hand frame. Count up two frames. Count left one frame. What frame next to that frame has the largest number? One...two...three." (15D[2,503])

The exercise above is a difficult one. A simple one would be like the exercise below.

After I give the instructions and count to three, you may begin to search. Go to page 1. What frame is on the top left-hand side of the page? One...two...three. (1A[7])

Students can take it in turns to give similar instructions to each other. Both need to agree on the number of steps in the instructions.

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