Transformation by design unit outline: Year 7 Number

Beautiful number patterns

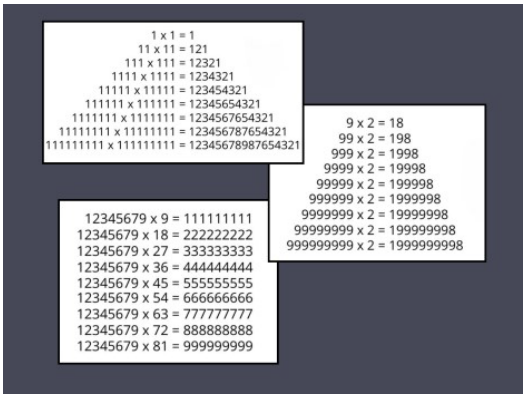
Main idea

- Humans, made in God's image, have created a number system that contains its own patterns and beauty.

Biblical perspective (creation, fall, redemption, restoration)

Creation

- God created our beautiful world. He set reliable patterns in place, creating order out of chaos.
- He saw everything He made and pronounced it 'good' (Genesis 1).
- Humans, made in God's image, have created a number system that contains its own patterns, beauty, and order.
- Psalm 19:1 and Job 38 give some insight into the awesome world that God created.



Fall

- Humans may hold the belief that everything in the world can be understood through human wisdom and/or knowledge of mathematics and science.
- Humans may worship that which is created rather than the creator.
- Mathematics is reduced to black-and-white numbers in a textbook. Beauty and context are lost.
- Romans 1:20-23

Redemption and Restoration

- Romans 8, especially 1–2; 18–25 tells us that the saving work of Jesus makes it possible to worship the Creator, not the created, and carries the hope that one day all of creation will also be restored to its fullness and beauty.
- With God's help, we can notice beautiful number patterns in our number system.
- We can delight in these patterns in the same way we appreciate a beautiful piece of music; artwork; or a beautiful piece of writing or poetry. God has wired us this way.
- With God's help, we use mathematical patterns and structures as a tool to clearly explain things to others and solve problems.

"The heavens declare the glory of God; the skies proclaim the work of his hands. Day after day they pour forth speech; night after night they reveal knowledge. They have no speech, they use no words; no sound is heard from them. Yet their voice goes out into all the earth, their words to the ends of the world." Psalm 19:1-4

Threads

PONDERING CREATION Students contemplate both the Creator and His handiwork and respond in delight and praise.

DISCOVERING PATTERNS Students explore and discover God's patterns and designs for delighting in and/or using for the benefit of all.

Enduring understandings	Essential questions
• As we increasingly 'tune into' number patterns, we increasingly see the beauty in the number system.	***How does maths help us stand in awe of God?*** • What makes a pattern a pattern? Can you safely mess with a natural pattern?

Misconceptions

- Everything can be understood by human wisdom, or through mathematics and science.
- Mathematics is what is found in a school textbook and is boring

Life-long learning

Heart: Maths helps me grow in appreciation of aspects of the created world, and stand in awe of God

Head: With God's help I notice beautiful number patterns in our number system

Heart: (With God's help), I use Maths as a tool to clearly explain things to others and solve problems

Australian Curriculum Outcomes ACARA 9.0

Strand: Number

- Describe the relationship between perfect square numbers and square roots, and use squares of numbers and square roots of perfect square numbers to solve problems AC9M7N01
- Represent natural numbers as products of powers of prime numbers using exponent notation AC9M7N02
- Represent natural numbers in expanded notation using place value and powers of 10 AC9M7N03
- Use the 4 operations with positive rational numbers including fractions, decimals and percentages to solve problems using efficient calculation strategies AC9M7N06
- Use mathematical modelling to solve practical problems involving rational numbers and percentages, including financial contexts; formulate problems, choosing representations and efficient calculation strategies, using digital tools as appropriate; interpret and communicate solutions in terms of the situation, justifying choices made about the representation AC9M7N09

Christian perspective: framing activities

Number General

Key message "story" to continually repeat to students:

- Humans, made in God's image, have created a number system which contains beauty.
- We can delight in these patterns in the same way we appreciate a beautiful piece of music; artwork; or a beautiful piece of writing or poetry. God has wired us this way.
- "The mathematician's patterns like the painter's or poet's, must be beautiful; the ideas, like the colours or the words, must fit together in a harmonious way. Beauty is the first test; there is no permanent place in the world for ugly mathematics" (Hardy, 1940, p.85)

- Unit outline for students and self-reflection rubric
- Cover pages for workbooks

- Mathematics in everyday life – homework task. Also encourages family interactions (appendix 1)

- Intersperse skills & drills from worksheets/ textbook with activities that draw out mathematical patterns. For instance:
    - Filling in a 15 by 15 Times table grid: 2's row/column; use a ruler against the 2's to double and fill in the 4's row/column (this is double the 2's row/column); ruler against 4's to double and fill in the 8's row/column – this is double-double. Repeat with 3; double 3's is 6; double-double is 12's row and column. 5 and 10 are easy. Introduces the idea of factors; multiples; and prime factors. Square numbers are the diagonal. (appendix 2)
    - Divisibility patterns
    - Prime number sieve (appendix 3)
    - "Paper folding" (appendix 4
    - Exponential laws and patterns (appendix 5)
    - Prime factor activity (appendix 6)
    - "Prime climb" activity https://mathforlove.com/lesson/prime-climb-color-chart/
    - Other…

- "God built prime numbers into creation (e.g. the Periodical Cicada); they are the building block of the number system and contain their own beauty
- "The Code" Part 1: numbers – "the Periodical Cicada" segment. This is the start – if you have access to the full show, he explains the 'prime number' aspect more clearly. However, this is the first few minutes: https://www.youtube.com/watch?v=VK90s8wMyyo

  Or
- https://www.youtube.com/watch?v=j_zV2Ll3wpg

End of topic exam

- On the first page of the exam include these questions [2 marks each based on thoughtful answers]:
- One example of a beautiful number patter is…
- Understanding exponential growth and how quickly coronavirus spreads helps me help others by….
- One other thing I have learnt this term is…
- Now go back and fill in the self-evaluation (include the self-evaluation rubric on the next page)

Mathematics in everyday life

Name:

Please take some time to answer these questions. You need to give me AS MANY examples as you can find (more than 4 in each section) and be as detailed as you like. Use the other side of this sheet if you run out of room.

1. What part of God's creation do you find particularly amazing? How does maths help us understand this?

2. What are some ways that you use maths every day?

3. Ask an adult in your house how they use maths:
    a. Around the house/ everyday life

    b. In their workplace

4. What leisure activity do you enjoy? (e.g. sports, crafts, music etc) Why is maths important in these activities?

Times tables: Looking for patterns

Our number system is full of patterns!

Discovering patterns:

1. Allows us to see beauty in numbers!

2. Helps us take shortcuts and be better able to manipulate numbers (solve problems)

Activity

Use the 15×15 grid

We will look for patterns in the grid therefore it is ***VERY important that you fill in the grid in the following order***

Tick as you go

Part 1

1. Fill in the 2's column and Row
2. Leave the 3's for now
3. DOUBLE each 2's answer to fill in the 4's column
4. Double each 2's answer to fill in the 4's row
5. Leave the 5,6,7 for now
6. DOUBLE the 4's column filled in (step 3) and fill in the 8's column
7. Double the 4's row filled in (step 4) and fill in the 8's row

Question: Why can we do this? Is this an easier way to think about our 8 times tables?

Appendix 2

Part 2

1. Fill in the 3 times table row/column
2. DOUBLE the row/column and fill in across and down the 6 times table row/column

Question: Why can we do this? Is this an easier way to think about our 6 times tables? Can we now double again for the 9 times table row/column? Why or why not?

Part 3

1. Fill in the 9 times table row/column
2. Fill in the 1; 5 and 10 times row/column (most people find this very easy to do)

What is left? Why do you think this number is left?

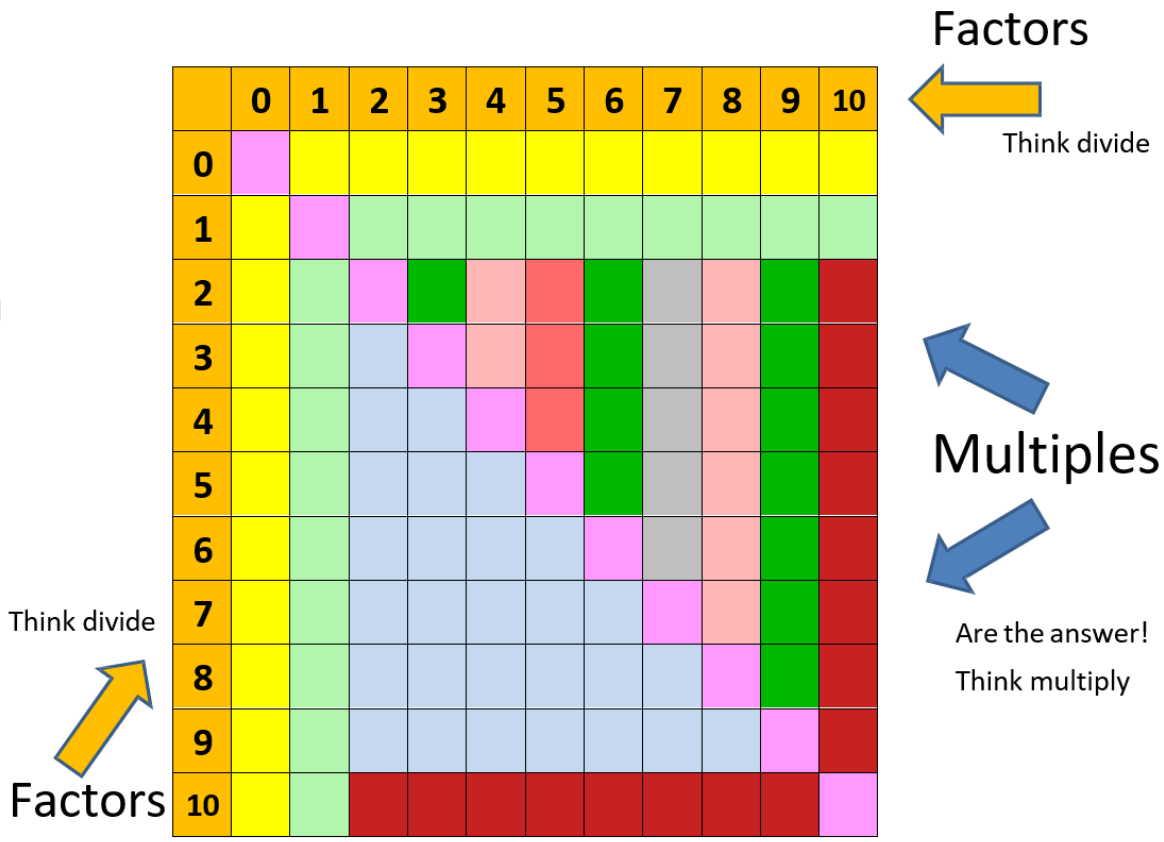
Highlight the numbers diagonally down the middle - these are special numbers - what are they called?

From the grid, what are examples of factors and what are examples of multiples?

Appendix 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															

Appendix 2


Factors
Think divide
Multiples
Are the answer!
Think multiply
Think divide
Factors

Exploring Prime Numbers

1. 2's
    a. Circle all the multiples of 2 except 2
    b. What do you notice?

    c. Explain what you see?

2. 3's
    a. In a DIFFERENT COLOUR: circle all the multiples of 3 except 3
    b. What do you notice

    c. Explain what you see

    d. Did you have to circle any numbers that were already circled? If so, which ones?

    e. Why are some numbers circled twice and others only once?

3. 4's
    a. In a DIFFERENT COLOUR: circle all the multiples of 4 except 4
    b. What do you notice. Explain what you see

    c. Did you have to circle any numbers that were already circled? If so, which ones?

4. 5's
    a. In a DIFFERENT COLOUR: circle all the multiples of 5 except 5
    b. What do you notice. Explain what you see.

    c. Why are some numbers crossed out twice and others only once?

5. 6's
    a. In a DIFFERENT COLOUR: circle all the multiples of 6 except 6
    b. What do you notice. Explain what you see.

6. 7's
    a. In a DIFFERENT COLOUR: circle all the multiples of 7 except 7
    b. What do you notice. Explain what you see.

7. What is special about the numbers you haven't circled out?

8. Which numbers get circled more than once, and why?

9. Which possible factors do we need to consider in order to decide if a number is prime?

10. List the prime numbers

Appendix 3

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Appendix 3

Prime Number Sieve

1	2	3	4.	5	6.	7	8	9	10
11	12.	13	14	15	16	17	18.	19	20
21	22	23	24.	25	26	27	28	29	30.
31	32	33	34	35	36.	37	38	39	40
41	42	43	44	45	46	47	48.	49	50
51	52	53	54	55	56	57	58	59	60.0
61	62	63	64	65	66	67	68	69	70
71	72.	73	74	75	76	77	78	79	80
81	82	83	84.0	85	86	87	88	89	90.
91	92	93	94	95	96.	97	98	99	100

Key

2's
3's
4's
5's
6's
7's
prines

Index Numbers – NO CALCULATOR

1. Write each of the following in *index form*

   a. 2 x 2 x 2 x 2

   b. 5 x 5 x 5

   c. 3 x 3 x 3 x 3

   d. 2 x 2 x 2 x 2 x 2

   e. 4 x 4 x 4

   f. 6 x 6 x 6 x 6

2. Write down how you would 'say' each of the following and then write in *expanded form*

   a. 3^4

   b. 5^2

   c. 2^6

   d. 7^3

   e. 8^2

3. Write each of the following in *expanded form* and then work out the *actual value*

   a. 2^3 =
   =

   b. 3^2 =
   =

   c. 4^5 =
   =

   d. 5^3 =
   =

   e. 6^4 =
   =

4. Write the following in *index form* and then find the *actual value* of:

   a. Six squared =
   =

   b. Eight squared =
   =

   c. Two cubed =
   =

   d. Four to the power of three
   =
   =

   e. Ten to the power of four
   =
   =

5. Fill in the table and look for patterns in each section!

	Index form	Base	Index	Expanded form	Basic Numeral
3a	2^2				
B	3^3				
C	0^3				
D	6^2				
E	1^7				
F	8				
G	7^3				
H	10^5				
I	6				
J	0^6				

k. Finish the sentences by looking at your answers above

- When the base is 1 the basic numeral will always be…
- When the base is 0 the basic numeral will always be…
- A whole number with no index written, really has an index of …

4a	2^1				
b	3^1				
c	4^1				
d	5^1				
e	What's the pattern?				

Appendix 5

	Index form	Base	Index	Expanded form	Basic Numeral
5.a	2^1				
b	2^2				
c	2^3				
d	2^4				
e	2^5				
f	1^2				
g	2^2				
h	3^2				
i	4^2				
j	5^2				
k	6^2				
l	7^2				
m	8^2				
n	9^2				
o	10^2				
p	Explain what the difference is between 5a-e AND 5 f-o:				
q	What makes a number a square number? Where does it get this name from? Shade over the “square numbers” (the ones in the ‘basic numeral’ column)				

Appendix 5

	Index form	Base	Index	Expanded form	Basic Numeral
6a	10^1				
b	10^2				
c	10^3				
d	10^4				
e	10^5				
f	10^6				
g	What's the pattern?				
7	Use a calculator for the next questions				
a	3^0				
b	6^0				
c	1000^0				
d	$536{,}783^0$				
e	0^0				
f	5.6^0				
g	$1{,}000{,}000{,}000^0$				
h	What's the pattern?				

Appendix 6

Factor Code

The Big Questions:

Investigate how 'prime factors' might be the building blocks of our number system. How can we best write a number as an expression of its prime factors?

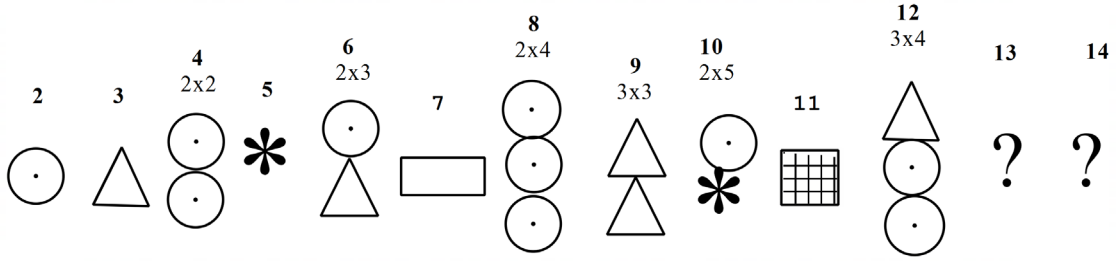
Equipment Needed:

- Coloured pens and/or stamped shapes (at least 12 varieties)
- A3 Paper, glue

Activity

The pattern below is a secret code where each different symbol represents a different number. If numbers can be **multiplied together** to give another number, then no new symbol is used.

Below are the first 12 numbers. Study them!



1. Start with the number 2, as shown, and work across to make a colorful poster.
2. Write a **heading** for each number using the number sentence of how you plan to make it. Use only 2 numbers multiplied together.
3. Use these symbols or make up your own (with colour or stamped shapes) and make the number.
4. Continue the code until you reach the number 30, or longer if time.
5. It is very important that you write which 2 numbers you multiplied together to make the numbers (where possible).

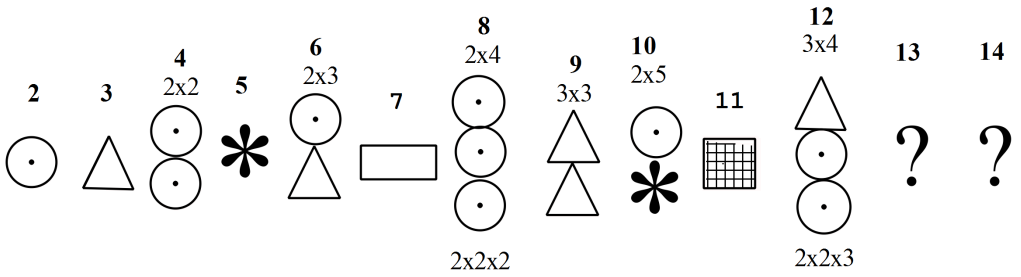
Turn over and answer the questions

Appendix 6

Discussion

7. **<u>Where you have 3 or more symbols</u> :** Go back and write the number sentences underneath using index numbers (with a 'x' sign in between and check it equals the heading!)

   The numbers 8 and 12 are shown below



8. When did you have to make up a new symbol style and why?
9. When numbers could be made in more than one way – what did you notice about the individual symbols for these numbers?

   For instance, 12 could be made by 3 x 4 *or* 2 x 6

   Would this change the symbols?

10. Use this diagram to explain the words
    a. Factor
    b. Prime number
    c. Index number?
11. Why was the symbol for 2 used so frequently?
12. What prime factors would make up the number 100?

Conclusion

13. Answer the big question

Appendix 6

Student work example – Factor code