This **Inclusion and Home Learning Guide** is part of a Learning Pack
downloadable from the AIMING HIGH website https://aiminghigh.aimssec.ac.za
It provides related activities for all ages and learning stages from pre-school to school-leaving,
together with guidance for inclusion in school lessons and for home-learning,
all on the Common Theme 'Properties of the number 2026'
Choose what seems suitable for the age or attainment level of your learners.

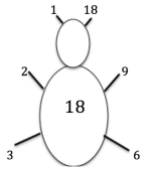
THE ANSWER IS 2026, BUT WHAT IS THE QUESTION?

2026 **What different questions can you find with 2026 as the answer? You can be a creative mathematician, someone who has your own mathematical ideas.**

Perhaps you can make up an easy question, a hard one and one that is very hard. Compare your questions with other people's. For example, you might ask: 'What do you add to 1066 to get the answer 2026?'.

Find your own interesting facts about 2026 and calculations with the answer 2026 or just investigate a few of the properties of 2026 below. For example you might ask:

1. Do you find anything interesting if you reverse the digits of 2026 and add the two numbers together?
2. Is it correct to say "twenty twenty-six" or should we say "two thousand and twenty-six" or are both correct? Why?
3. People say "twenty twenty-six" so do the 2 twenties mean – 20 thousands, 20 hundreds, 20 tens or 20 units?
4. Find the prime factors of 2026 and write 2026 as a product of its prime factors.
5. Here is the factor bug for 18. The antennae show $1 \times 18 = 18$. The pairs of legs show and $2 \times 9 = 18$ and $3 \times 6 = 18$. For square numbers instead of a pair of legs the bug has a tail. For example the 16-bug has a tail for 4. Factor bugs for other numbers can have more legs. How many legs for 2026? Does it have a tail?



6. 2026 is the sum of two squares $45^2 + 1^2$. Check it out.
7. 2026 is the sum of 3 squares. If one is 37^2, can you find the other two? How many other ways of writing 2026 as the sum of 3 squares can you find if you ask AI?
8. Investigate whether the number 2026 is happy or sad. A ***happy number*** is a positive integer that, when replaced by the sum of the squares of its digits, and this process is repeated, the number chain eventually reaches 1. If the process results in an endless cycle without ever reaching 1, the number is considered unhappy or sad.
   For example 79 and 97 are happy numbers because $7^2 + 9^2 \rightarrow 49 + 81 = 130 \rightarrow 1^2 + 3^2 = 10 \rightarrow 1^2 + 0^2 = 1$ and 4 is a sad number because $4 \rightarrow 16 \rightarrow 37 \rightarrow 58 \rightarrow 89 \rightarrow 145 \rightarrow 42 \rightarrow 20 \rightarrow 4$ and this cycle of 8 numbers repeats over and over again indefinitely.
9. What is 2026 written in Roman Numerals?
10. What is the number 2026 written as a binary number?

What interesting facts can you find about the year that you were born?

HELP

How old are you? If you are 9 years old then write down some interesting calculations that have the answer 9 (or whatever your age is, do the same for your age).

For example, all these have the answer 9:

3×3 ; half of 18 ; 10 – 1 ; 20 – 11; 16 -7 ; 3^2 ; square root of 81 etc.

See the problem 'I'm Eight'

https://aiminghigh.aimssec.ac.za/years-3-10-i-am-eight/

NEXT

How many ways can you arrange the digits 2, 0, 2 and 6 to get different numbers? What is the sum of those numbers?

Explore Wild and Wonderful Number Patterns, see http://nrich.maths.org/33
Make up some of your own number patterns.
You've probably come across number patterns before, ones like :-
2 4 6 8 10 12 . . .
512 256 128 64 32 . . .
220 210 200 190 180 170 . . .
11 14 17 20 23 26 . . .
Work out the rules that produced each of the patterns.
What is the reason for the series of dots appearing after each one?
Now make up some of your own number patterns.

INCLUSION AND HOME LEARNING GUIDE
THEME: PROPERTIES OF THE NUMBER 2026

Early Years and Lower Primary

Understanding time and related vocabulary.

2026 Look together at the pictures of the four seasons. Ask the children to tell you what they see in the pictures. Talk about the names of the seasons. If you are in a region that does not have four seasons then omit this or talk about the differences between regions.

Use a calendar for 2026. If your calendar has pictures, look at them together and ask the children to tell you what they see in the pictures. Do they like the pictures? Why?

Ask about their birthdays. Find their birthdays on the calendar.

January

Su	M	Tu	W	Th	F	Sa
				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

February

Su	M	Tu	W	Th	F	Sa
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

March

Su	M	Tu	W	Th	F	Sa
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				

April

Su	M	Tu	W	Th	F	Sa
			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		

May

Su	M	Tu	W	Th	F	Sa
					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						

June

Su	M	Tu	W	Th	F	Sa
	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				

July

Su	M	Tu	W	Th	F	Sa
			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	

August

Su	M	Tu	W	Th	F	Sa
						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					

September

Su	M	Tu	W	Th	F	Sa
		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			

October

Su	M	Tu	W	Th	F	Sa
				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

November

Su	M	Tu	W	Th	F	Sa
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					

December

Su	M	Tu	W	Th	F	Sa
		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		

Talk about the months, ask them to count the 12 months of the year. Talk about the names of the months.

How many months are there to their next birthday?

Talk about the weeks, ask them to count the 7 the days of the week and talk about the names of the days.

On what days of the week will their birthdays occur in 2026?

How many days are there in the months?

Look for patterns in the numbers on the calendar. The numbers in the rows increase by 7 and in the columns by 1.

Ask learners how old they will be on their birthday in 2026?

In which year were they born? Count from the year of their birth up to 2026: for example, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026. So someone born in 2019 will be 7 years old in 2026.

Upper Primary and Lower Secondary Years 4 – 10

Developing independent learning and understanding of factors.

Copy this question on the board:

THE ANSWER IS 2026, BUT WHAT IS THE QUESTION?

This is a good activity for the start of the school year. It can be adapted year by year to 'The answer is 2026…' or 'The answer is 2027…' etc. There is no need for assessment of prior knowledge for this activity, but teachers can use the activity to assess what understanding of number operations and what number sense and creativity the individual learners have. Tell them that you want them to create their own calculations that have the answer 2026 or involve the number 2026. This will automatically lead to differentiation and all learners can be successful.

It is worthwhile to have a preliminary discussion about the number 2026, what words we use to talk about it and place value.

Explain to learners that they can and should be able to think for themselves like mathematicians and not just follow instructions and copy other people. Explain that computers now do all the routine jobs and, in this century, higher skills are needed. Tell them that sometimes you are going to give them problems without telling them what to do to solve them but that you will teach them a lot of new mathematics so that they will get better and better at problem solving.

You might like to use the 'One-Two-Four-More' strategy getting the learners to work individually until each learner has a calculation that gives the answer 2026. Then tell the learners to work in pairs to check that their partner's calculation does have the answer 2026. Then ask the learners to work in fours. Perhaps each group could make a poster showing some calculations that have the answer 2026.

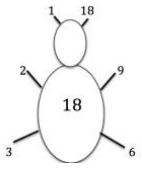
Ask each group to explain one of their 'calculations' and the class could vote on which is the 'most interesting'. You could have a class discussion as to what would make these 'made-up questions' interesting.

Another challenge would be to investigate whether the number 2026 is happy or sad. A ***happy number*** is a positive integer that, when replaced by the sum of the squares of its digits, and this process is repeated, the chain of numbers eventually reaches 1. If the process results in an endless cycle without ever reaching 1 the number is considered unhappy or sad. For example:

79 and 97 are happy numbers because $\mathbf{7^2 + 9^2} \rightarrow \underset{49+81}{\mathbf{130}} \rightarrow \underset{1+9}{\mathbf{10}} \rightarrow \underset{1+0}{\mathbf{1}}$

What about the number 4? By the same process $4 \rightarrow 16 \rightarrow 37 \rightarrow 58 \rightarrow 89 \rightarrow 145 \rightarrow 42 \rightarrow 20 \rightarrow 4$ and this cycle of 8 numbers repeats over and over again indefinitely so 4 is a sad number. Ask the learners to check it out and to find out if 2 and 3 are happy or sad.

Ask the learners to find the prime factors of 2026. Here is the factor bug for 18.
The antennae show 1 × 18 = 18. The pairs of legs show and 2 × 9 = 18 and 3 × 6 = 18.
Factor bugs for other numbers can have more legs. For square numbers, instead of a pair of legs the bug has a tail. For example the 16-bug has a tail for 4.



Draw the factor bug for 2026. How many legs does it have? Does it have a tail?

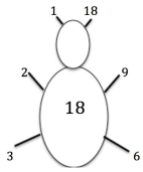
Key questions

- Can you explain your method to me and how it works?
- What answer does your calculation give when you work it out?
- What could you add to your answer to get 2026?
- Can you use other operations (such as subtraction, multiplication, division, squaring etc)?

Secondary Years 9 to 12

HOW MANY PROPERTIES CAN YOU FIND OF THE NUMBER 2026?

1. For example you might ask: 'Do you find anything interesting if you reverse the digits of 2026 and add the two numbers together?'
2. Is it correct to say "twenty twenty-six" or should we say "two thousand and twenty-six" or are both correct? Why?
3. People say "twenty twenty-six" so do the 2 twenties mean – 20 thousands, 20 hundreds, 20 tens or 20 units?
4. Find the prime factors of 2026 and write 2026 as a product of its prime factors. When is the next year that is a prime number?
5. Here is the factor bug for 18. The antennae show $1 \times 18 = 18$. The pairs of legs show and $2 \times 9 = 18$ and $3 \times 6 = 18$. For square numbers instead of a pair of legs the bug has a tail. For example the 16-bug has a tail for 4. Factor bugs for other numbers can have more legs. How many legs for 2026? Does it have a tail?



6. 2026 is the sum of two squares $45^2 + 1^2$. Check it out.
7. 2026 is the sum of 3 squares. If one is 37^2, can you find the other two? How many other ways of writing 2026 as the sum of 3 squares can you find if you ask AI?
8. Investigate whether the number 2026 is happy or sad. A ***happy number*** is a positive integer that, when replaced by the sum of the squares of its digits, and this process is repeated, eventually reaches 1. If the process results in an endless cycle without ever reaching 1, the number is considered unhappy or sad. For example 79 and 97 are happy numbers because $7^2 + 9^2 \rightarrow 49 + 81 = 130 \rightarrow 1^2 + 3^2 = 10 \rightarrow 1^2 + 0^2 = 1$ and 4 is a sad number because $4 \rightarrow 16 \rightarrow 37 \rightarrow 58 \rightarrow 89 \rightarrow 145 \rightarrow 42 \rightarrow 20 \rightarrow 4$ and this cycle of 8 numbers repeats over and over again indefinitely. Check it out and to find out if 2 and 3 are happy or sad.
9. What is 2026 written in Roman Numerals?
10. What is the number 2026 written as a binary number?
11. What interesting facts can you find about the year that you were born?

Upper Secondary Years 12 and 13 – addressed directly to students

1. Create some calculations using powers of whole numbers that give the answer 2026.

2. How many ways can you arrange the digits 2, 0, 2 and 6 to get different numbers? What is the sum of those numbers? Find a quicker way than simply adding the numbers to get the sum?

3. The number 2026 can be written as the sum of 2 squares in one way $1^2 + 45^2$.
   It can be written as the sum of 3 squares as $0^2 + 1^2 + 45^2$; find 8 other different ways allowing only positive integers a, b and c with $a \le b \le c$.

4. The French mathematician Lagrange proved, in 1770, that all natural numbers can be written as the sum of 4 squares. If you know how to do simple coding then write a program to show that 2026 can be written as the sum of four squares $a^2 + b^2 + c^2 + d^2$ of positive integers a, b, c and d with $a \le b \le c \le d$ in 69 different ways. Adapt your program to find all the sums of three squares.

   Does your program give the results in the table below for four squares?
   If you need help then adapt the pseudo-code on the next page to whatever language you know.

List of the 69 ways that 2026 can be written as the sum of four squares

count	*a*	*b*	*c*	*d*	count	*a*	*b*	*c*	*d*	count	*a*	*b*	*c*	*d*
1	**1**	**4**	**28**	**35**	25	**4**	**7**	**19**	**40**	49	**8**	**15**	**21**	**36**
2	**1**	**5**	**8**	**44**	26	**4**	**11**	**17**	**40**	50	**9**	**9**	**10**	**42**
3	**1**	**5**	**20**	**40**	27	**4**	**16**	**23**	**35**	51	**9**	**10**	**18**	**39**
4	**1**	**6**	**15**	**42**	28	**4**	**19**	**25**	**32**	52	**9**	**12**	**24**	**35**
5	**1**	**6**	**30**	**33**	29	**5**	**8**	**16**	**41**	53	**10**	**11**	**19**	**38**
6	**1**	**8**	**19**	**40**	30	**5**	**10**	**26**	**35**	54	**10**	**14**	**19**	**37**
7	**1**	**13**	**16**	**40**	31	**5**	**13**	**26**	**34**	55	**10**	**17**	**26**	**31**
8	**1**	**15**	**30**	**30**	32	**5**	**14**	**19**	**38**	56	**10**	**25**	**25**	**36**
9	**1**	**16**	**20**	**37**	33	**5**	**16**	**28**	**31**	57	**11**	**14**	**22**	**35**
10	**1**	**20**	**20**	**35**	34	**5**	**19**	**22**	**34**	58	**11**	**16**	**25**	**32**
11	**1**	**20**	**28**	**29**	35	**5**	**22**	**26**	**29**	59	**12**	**15**	**19**	**36**
12	**2**	**2**	**13**	**43**	36	**6**	**6**	**27**	**35**	60	**13**	**17**	**28**	**28**
13	**2**	**5**	**29**	**34**	37	**6**	**15**	**26**	**33**	61	**14**	**23**	**25**	**26**
14	**2**	**7**	**23**	**38**	38	**6**	**18**	**21**	**38**	62	**15**	**15**	**26**	**30**
15	**2**	**10**	**31**	**31**	39	**6**	**19**	**27**	**30**	63	**15**	**21**	**24**	**28**
16	**2**	**11**	**26**	**35**	40	**7**	**7**	**22**	**38**	64	**16**	**16**	**17**	**35**
17	**2**	**13**	**22**	**36**	41	**7**	**8**	**8**	**43**	65	**16**	**19**	**25**	**28**
18	**2**	**17**	**17**	**38**	42	**7**	**10**	**14**	**41**	66	**16**	**20**	**23**	**29**
19	**3**	**12**	**28**	**33**	43	**7**	**11**	**16**	**40**	67	**17**	**18**	**18**	**33**
20	**3**	**18**	**18**	**37**	44	**7**	**13**	**28**	**32**	68	**18**	**19**	**21**	**30**
21	**3**	**21**	**26**	**30**	45	**7**	**14**	**25**	**34**	69	**22**	**22**	**23**	**23**
22	**4**	**4**	**25**	**37**	46	**7**	**25**	**26**	**26**					
23	**4**	**5**	**7**	**44**	47	**8**	**8**	**23**	**37**					
24	**4**	**5**	**31**	**32**	48	**8**	**12**	**27**	**33**					

SOLUTIONS

For younger learners any sum that gives the answer 2026 is a solution. Learners should find many different ways to get 2026 and share their ideas with each other. For example 1010 + 1010 + 6 = 2026.

$2 \times 1010 + 6 = 2026$ or

$4 \times 505 + 6 = 2026$ or

$5 \times 404 + 6 = 2026$ or …

Clearly there are many simple solutions.

Older learners may find more complicated calculations that give the answer 2026. Some solutions are more accessible and more interesting than others. What is interesting for 10 year-olds may not be interesting for 18 year-olds and vice versa.

1. If you reverse the digits of 2026 and add the two numbers together:
   2026 + 6202 = 8228, you get a palindromic number.
2. Although commonly used 'twenty twenty-' is not correct and we should say 'two thousand and twenty-six' given by: (2 × 1000) + (2 × 10) + 6 = 2026.
3. People do say 'twenty twenty' and that means 20 hundreds and 20 units. We can write this:
   (20 × 100) + (20 × 1) + 6 = 2026 but this is not the usual format for our place value system which should be: (2 × 1000) + (0 × 100) + (2 × 10) + 6 = 2026.
4. The prime factors of 2026 are 1, 2 and 1013 and 2026 = 1 × 2 × 1013.
5. The factor bug for 2026 has only 2 legs and they are for 2 × 1013. There is no tail.
   The antennae show 1 × 2026 = 2026.
6. 2026 can be written as the sum of two squares in one way: $45^2 + 1^2$
7. 2026 can be written as the sum of 3 squares as:
   $0^2 + 1^2 + 45^2$
   $1^2 + 27^2 + 36^2$
   $3^2 + 9^2 + 44^2$
   $8^2 + 21^2 + 39^2$
   $9^2 + 24^2 + 37^2$
   $12^2 + 19^2 + 39^2$
   $15^2 + 24^2 + 35^2$
   $17^2 + 21^2 + 36^2$
   $19^2 + 24^2 + 33^2$
8. The number 2026 is a ***happy number*** because
   2026 = → **44** $(=2^2 + 2^2 + 6^2)$→ **32** $(= (4^2 + 4^2) \rightarrow$ **13** $(=3^2 + 2^2)$→ **10** $(=1^2 + 3^2) \rightarrow$ **1**
9. 2026 written in Roman Numerals is MMXXV1
10. 2026 written as a binary number is 11111101010

    that is in decimal notation:

    $2^{10} + 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^3 + 2 = 1024 + 512 + 256 + 128 + 64 + 32 + 8 + 2$

Upper Secondary Years 12 and 13

2. The digits 2, 0, 2 and 6 can be arranged in 12 ways to get different numbers?

2026	6202
2062	6220
2206	6022
2260	0622
2602	0226
2620	0262

Adding the thousands, hundreds, tens and units separately, these numbers add up to:
30 000 + 3 000 + 300 + 30 = 33 330

3. 2026 can be written as the sum of 3 squares as:
$0^2 + 1^2 + 45^2$
$1^2 + 27^2 + 36^2$
$3^2 + 9^2 + 44^2$
$8^2 + 21^2 + 39^2$
$9^2 + 24^2 + 37^2$
$12^2 + 19^2 + 39^2$
$15^2 + 24^2 + 35^2$
$17^2 + 21^2 + 36^2$
$19^2 + 24^2 + 33^2$

4. **Pseudo-code to find sums of 4 squares that give the answer 2026 and the results**

```
count = 0
for a = (1:45)
for b=(a:45)
for c=(b:45)
for d = (c:45)
if 2026 == a^2+b^2+c^2+d^2
count = count + 1;
y=[a,b,c,d];
disp(y)
end end end end end
```

Why do these activities?

This collection of activities gives open questions suitable for learners of all ages on number, factors and prime factorization, exponents and simple coding.

The question "2026 is the answer, what is the question?" is suitable for younger and less confident learners, and older learners can use their greater mathematical knowledge. Use this activity to encourage learners to think for themselves and to use everything they know about numbers to create their own solutions and to invent questions. This activity allows learners to be creative, to explore and play with numbers and to come up with their own solutions. It is also an example of an inverse problem, one that gives the answer so that the learner has to think of where to start to get to that answer.

Learning objectives

In doing these activities students will have opportunities to:

Primary:

- develop vocabulary about measures and cycles in the passage of time
- practise calculations involving operations that they know

Lower Secondary, all the above and:

- learn about factors and prime factorization.

Upper Secondary, all the above and:

- use some simple coding

Generic competences

In doing this activity students will have an opportunity to **think flexibly**, be creative and innovative and apply knowledge and skills.

Follow up

Calendar Patterns
https://aiminghigh.aimssec.ac.za/calendar-patterns/

Factors and Multiples Game
https://aiminghigh.aimssec.ac.za/factors-and-multiples-game/