Developing Students' Literacy Skills in Mathematics 7-12

Jennifer Woods
jwoods@aisnsw.edu.au

ais nsw
empowering **independent** education

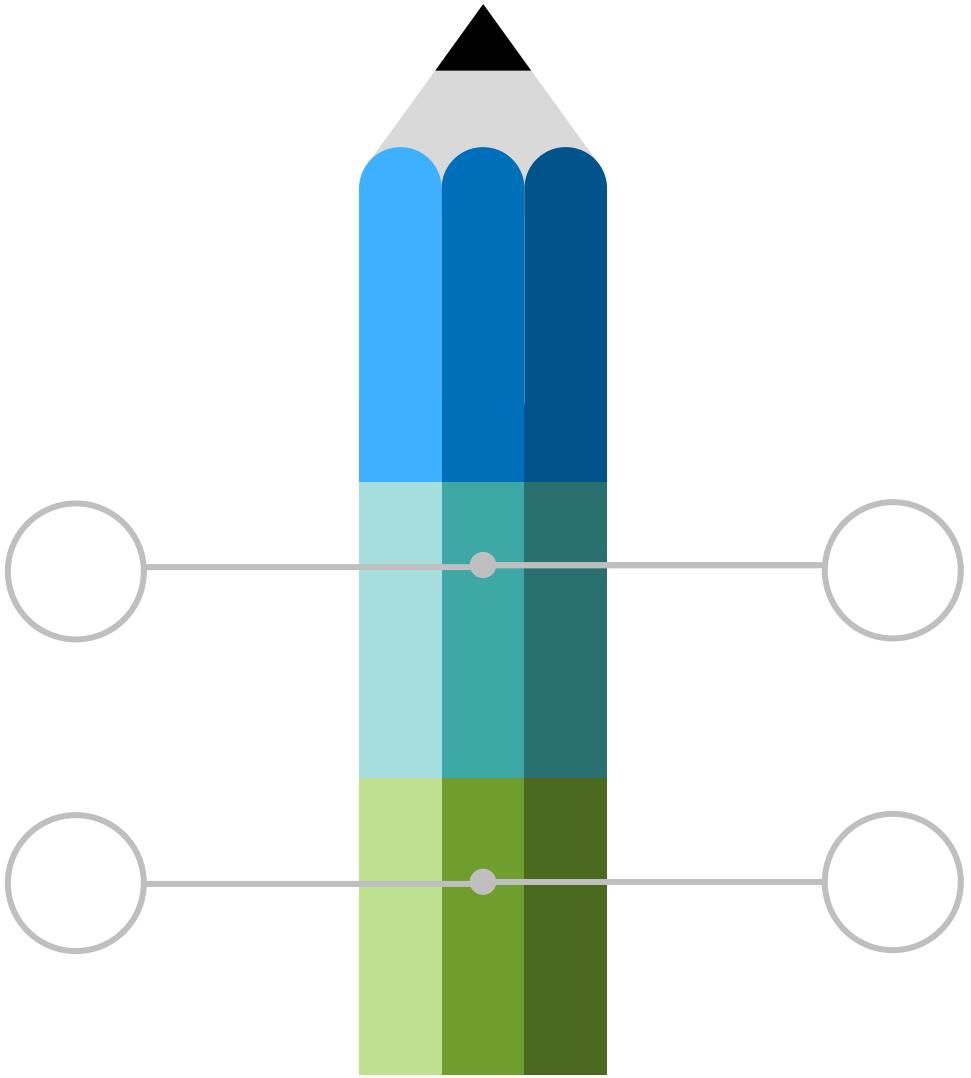
AISNSW

Acknowledgement of Country

Learning Intentions

To understand the need to develop student literacy skills in Mathematics

To discover a range of low-prep strategies to use daily in the classroom

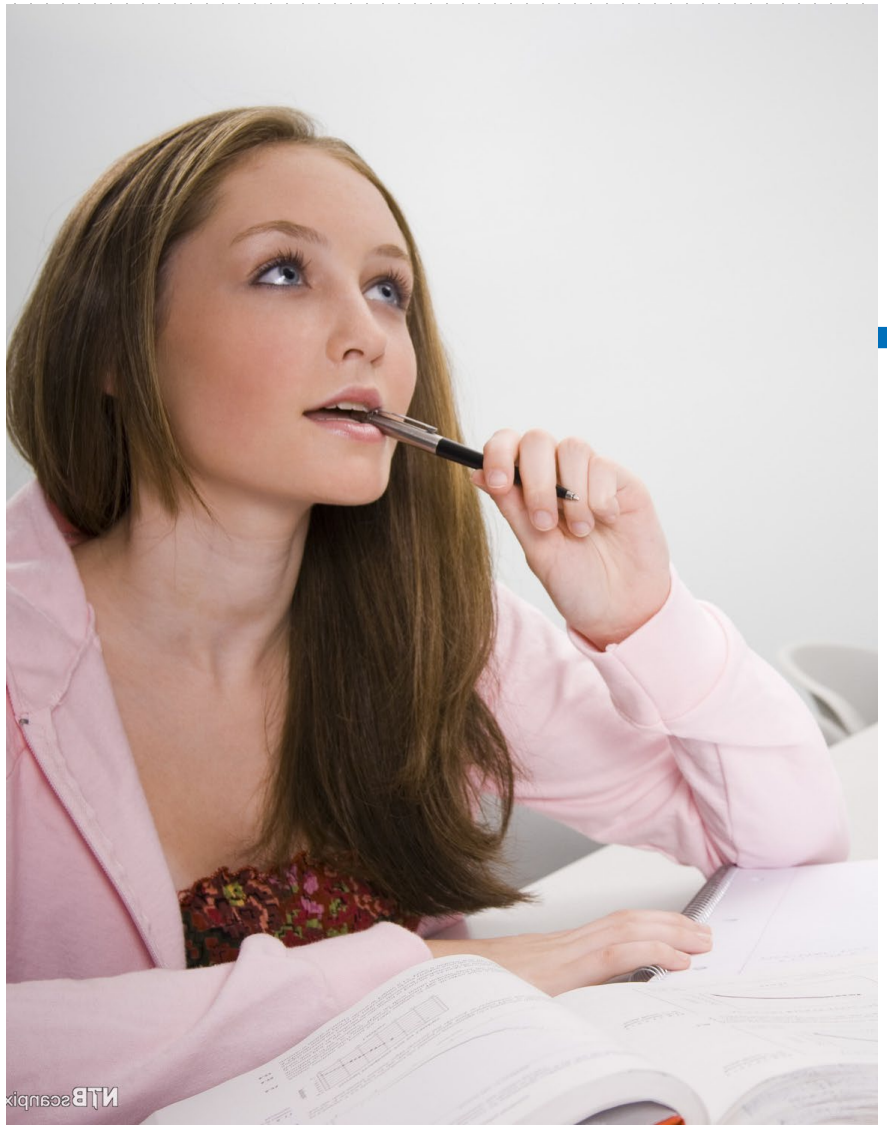


Success Criteria

You will be able to identify the needs and the opportunities to support the explicit teaching of literacy skills.

You will be able to create and use a range of strategies to support the development of student literacy skills.

https://bit.ly/LitMaths

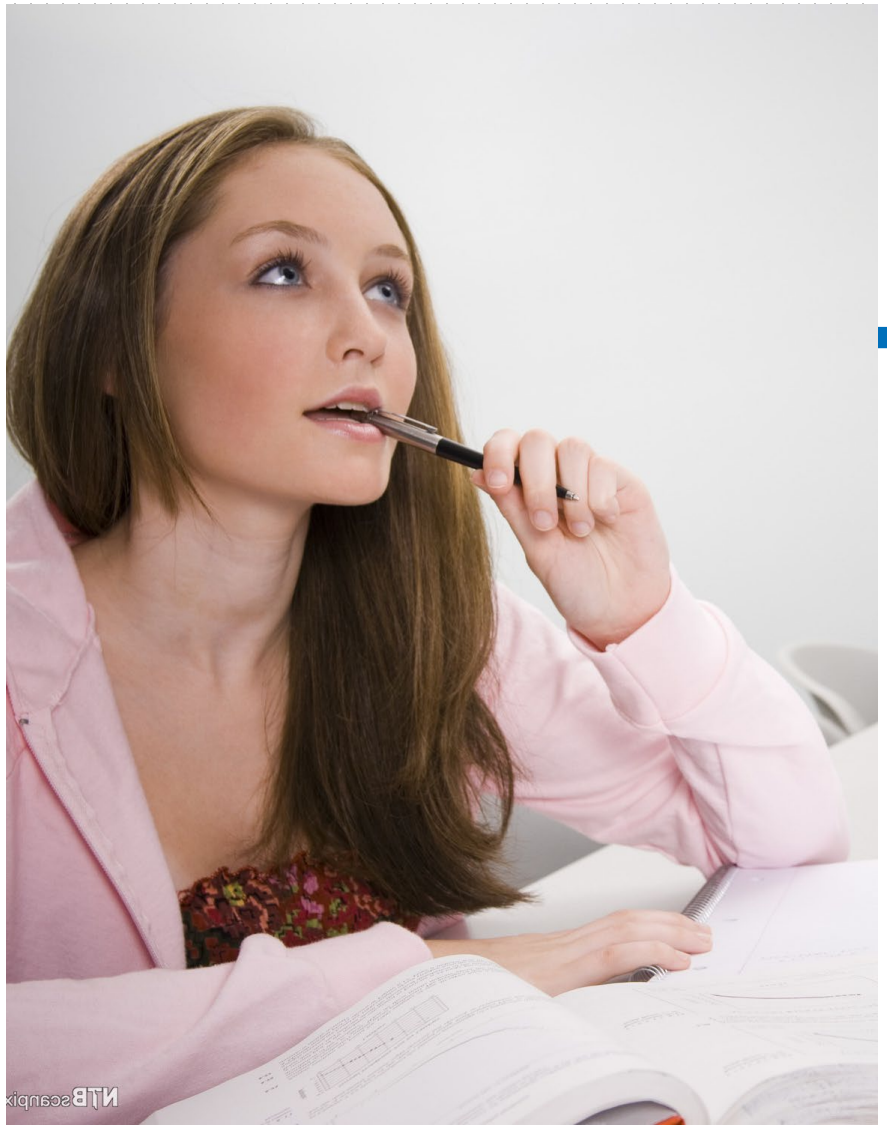


Literacy in Mathematics

Why are we talking about it?

There is an increased need for students to:

- Read and understand worded questions
- Write responses in sentences
- Working mathematically embedded in the new 7-10 syllabus – reasoning and communication



Literacy in Mathematics

What do we mean by literacy in Mathematics?

- Reading and decoding
- Writing
- Understand and use command verbs
- Specialist vocabulary

Working Mathematically

A student develops understanding and fluency in mathematics through:

- exploring and connecting mathematical concepts,
- choosing and applying mathematical techniques to solve problems, and
- communicating their thinking and reasoning coherently and clearly

Working Mathematically

Stage 4 Core Number and algebra

- Reason why an approximation may be more appropriate than an exact answer and vice versa

Stage 4 Fractions, decimals and percentages

- Recognise and explain that numbers with terminating or recurring decimals are rational

Working Mathematically

Stage 4 Core Properties of geometrical figures

- Justify why some quadrilaterals may be classified as more than one type of quadrilateral

Stage 4 Core Data Analysis

- Identify and explain the impact of adding or removing data values that are clustered at one end of a dataset on the measures of centre

Working Mathematically

Stage 5 Core Linear relationships B

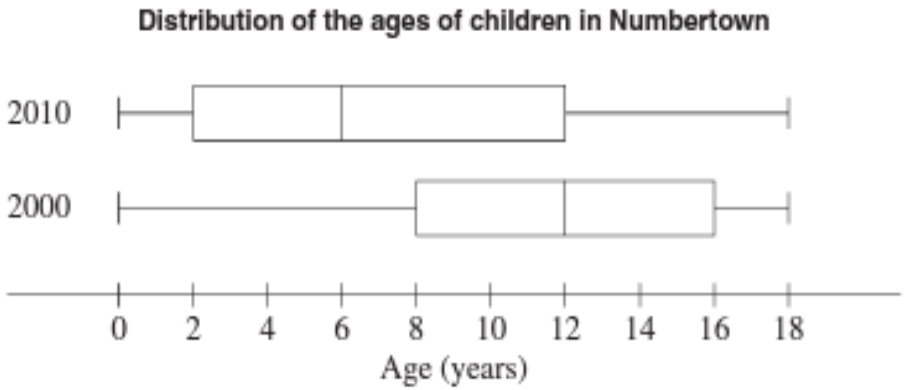
- Explain the effect of increasing or decreasing the gradient with or without digital tools

Stage 5 Core Data Analysis

- Compare and contrast the centre, spread and shape of 2 or more numerical datasets, using box plots and numerical statistics, including the 5-number summary

Supporting Student Responses

(b) The graphs show the distribution of the ages of children in Numbertown in 2000 and 2010.



(i) In 2000 there were 1750 children aged 0–18 years.

How many children were aged 12–18 years in 2000?

(ii) The number of children aged 12–18 years is the same in both 2000 and 2010.

How many children aged 0–18 years are there in 2010?

(iii) Identify TWO changes in the distribution of ages between 2000 and 2010. In your answer, refer to measures of location or spread or the shape of the distributions.

(iv) What would be ONE possible implication for government planning, as a consequence of this change in the distribution of ages?

(i) In 2000 there were 1750 children in total. Ages 12-18 represents half of the total. The number of children aged 12-18 years is 875.

(ii) In 2010 one quarter of the children were aged 12-18 years. The total number of children 0-18 years in 2010 is 3500.

(iii) Compare the data using a table

	Location: median	Spread: IQR, range	Shape
2010	6	10, 18	Positive skew
2000	12	8, 18	Negative skew

Between the year 2000 and 2010: the median age of children went down from 12 to 6, and the skew of the data changed meaning there were far fewer older children in 2010 than in 2000.

(iv) More childcare required for younger children and kindergarten places in schools.

Working Mathematically

Year 11 Standard (*Draft*) Data Analysis

- Compare and contrast the measures of centre, spread and shape using parallel box plots, with and without digital tools

Year 12 Standard 2 (*Draft*) Algebraic relationships

- Explain the limitations of quadratic models in practical contexts

Year 11 ADV (*Draft*) Introduction to differentiation

- Describe the behaviour of a function and its tangent at a point by examining the graph of the function, using language including increasing, decreasing and stationary when the tangent is parallel to the x-axis

Communicating – Writing in Maths

- Explain – the method you used or a given solution
- Describe – an error, solution or approach
- Justify or support your answer

Communicating – Writing in Maths

- Why did you use that process?
- Why does that answer seem reasonable?
- Why did you choose to do that?
- Why do you think that?
- Why is it an error?
- Why will you start with that step?

Characteristics of a Good Explanation

- Always written in complete sentences
- Clear and complete
- Can include a diagram or picture if needed
- Includes justification – “WHY?” for everything

Course Performance Descriptors - RoSA

- A – E Grades
- Based on Working Mathematically Skills

Course Performance Descriptors - RoSA

The key areas that are reflected in the descriptors are:

- Reasoning in mathematics
- Mathematical representations
- Use of mathematical language
- Knowledge and understanding
- Ability to solve routine problems
- Ability to solve non-routine problems

Course Performance Descriptors - RoSA

Grade C

A student performing at this grade typically:

- demonstrates sound understanding of the relationships between mathematical concepts
- uses and creates abstract or concrete representations in familiar situations
- solves routine problems of up to 3 steps in familiar situations and attempts routine problems of more than 3 steps
- identifies some connections between concepts when attempting non-routine problems
- uses informal mathematical reasoning to prove or justify results
- uses mathematical language to communicate reasoning and explain solutions

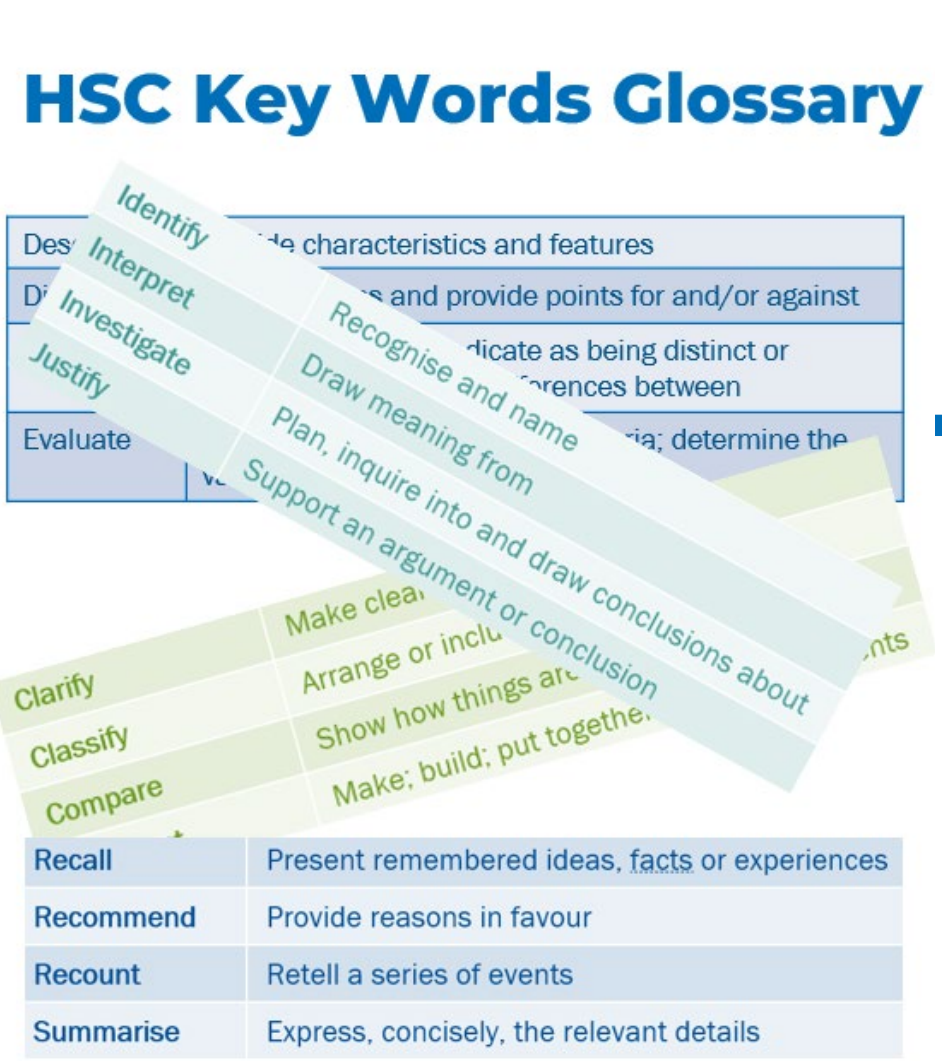
Assessing for the Course Performance Descriptors

Course performance descriptors provide holistic descriptions of typical achievement at different grade levels in a specific course.

They are used to identify and report a student's level of achievement in a Board Developed Course at the end of Stage 5.

Teachers should provide students with a variety of ways, **both formally and informally**, to demonstrate their achievement in relation to these descriptors.

Using different forms of assessment throughout the teaching and learning cycle allows all students to demonstrate their achievement in relation to the standards in the descriptors.



Working Mathematically Verbs

classify
contrast
describe
estimate
interpret
justify
compare
define
explain
generalise
infer
prove

Choose the correct word from the list for each question.

solve **factorise** **expand** **substitute** **simplify**

1. _____ $5(x + 3)$
   $= 5x + 15$

2. _____ $4x = 12$
   $x = 3$

3. _____ $y = 3$ into $4y + 2$
   $(4 \times 3) + 2 = 14$

4. _____ $5c + 2c + 4c$
   $= 11c$

5. _____ $5x + 15$
   $= 5(x + 3)$

Command Words

Words which give instructions to students about what to do in the question.

evaluate, simplify, substitute, find, solve, determine

Vocabulary **Name: _____**

Use the words in the list to make a match

term, equation, expression, pronumeral, solution

$y = -6$	
$5p$	
x	
$7x + 4 = 9$	
$8 - \frac{5t}{3}$	

Equations Matching Activity Name: _____

Choose an equation from the table and write it in the space next to the worded description.

The first one has been done for you. The equation can be used more than once.

$n - 5 = 20$	$n + 5 = 20$	$5 - n = 20$	$\frac{n}{2} + 5 = 20$
$5n = 20$	$\frac{n}{5} = 20$	$2n + 5 = 20$	$2(n + 5) = 20$

1.	A number was increased by 5 to give the answer 20.	$n + 5 = 20$
2.	Five times a number is 20.	
3.	Dividing a number by 5 gives 20.	
4.	A number is doubled then 5 is added. The result is 20.	
5.	A number is increased by 5 and the result is doubled to give 20.	
6.	A number is subtracted from 20 to give 5.	

Vocabulary: Tier Words

Tier 1:
Common everyday words

Tier 2:
Cross Curricula Academic Words

evaluate, average, plot, difference, mean, prime, solution, expression

Tier 3:
Specific Technical Words

circumference, numerator, quadrilateral, hypotenuse, integer, pronumeral, cosine, tree diagram

Identify the Tier Words in questions

Tier 2 Words:
Cross Curricula Academic Words

Underline

Tier 3 Words:
Specific Technical Words

Circle

https://bit.ly/LitMaths

Mathematics Glossary

Topic	Word	Definition	Diagram or example
Integers	Integer	A whole number, positive, negative or zero	…-3,-2, -1, 0, -1, 2, 3,…
	ascending	Numbers in order going up, getting larger, increasing	15, 16, 17, 18,… -8, -7, -6, -5,…
	descending	Numbers in order going down, getting smaller, decreasing	3, 2, 1, 0,… -11, -12, -13, -14,…
	greater than	The number 5 is greater than 4	$5 > 4$
	less than	The number -3 is less than zero	$-3 < 0$
	equivalent	Two things that have the same value (answer) are equivalent	5+2 is equivalent to 3+4
	inequality	A statement where one number is less than or greater than the other	$a < b$, $a > b$ $a \leq b$, $a \geq b$
	number line	A line used to represent the position of a number	

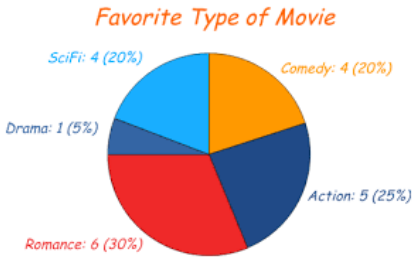
Name: _____

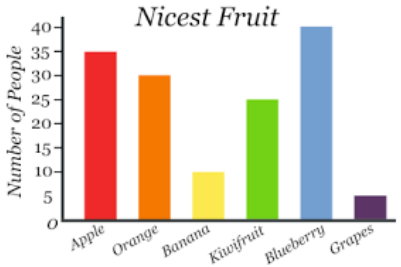
Graph Match Entry Ticket

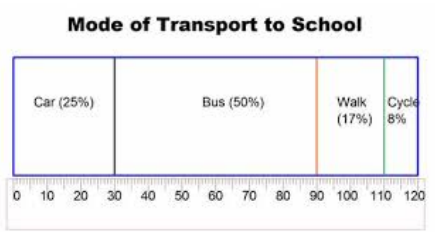
Write down the type of graph using the labels given:

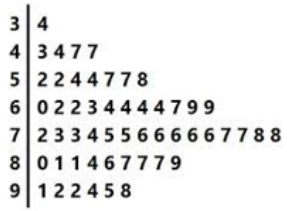
Column Graph Dot Plot Sector Graph Divided Bar Graph

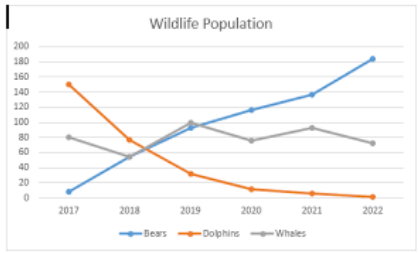
Line Graph Histogram Stem-and-Leaf Plot

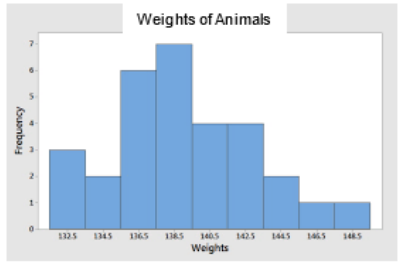












Glossary Activities

Exit Ticket - Cloze passage

Choose from the following words to complete the sentences below.

obtuse, alternate, equal, complementary, parallel, obtuse, transversal, 90, 180, supplementary

1. When a pair of lines are parallel, then the _____ angles formed are equal.
2. An _____ angle measures between 90 and 180 degrees.
3. When two straight lines intersect, the vertically opposite angles formed are _____.
4. When the size of two angles adds to 90^0 they are said the be _____.
5. An angle which measures between 0 and _____ degrees is called an acute angle.
6. A line which passes through a pair of parallel lines is called a _____.

https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/mathematics/mathematics-k-10/glossary

Glossary Activities

Terminology Match

Write the correct terms in the spaces below.

quantitative data discrete data continuous data

categorical data nominal data ordinal data

	Numerical data. It is data that can be measured.
	The result of counting and is usually given in whole numbers.
	The result of direct measurement. Includes data about length, mass, volume, time, capacity, height etc . The data will have a unit of measurement attached like cm, mL, min etc
	Data that is divided into categories such as hair colour. It uses words not numbers.
	Data that is classified by its name. Brand of car, type of phone, political party, etc.
	Data that implies a ranking or preference. Hotel star ratings, questionnaire responses (most/least likely) etc

Financial Mathematics – Cloze Passage

Complete each sentence with the correct word

interest flat borrowed compound

more balance faster term

An investment is an amount deposited into a savings account to earn _____ for a fixed period of time.

When you take out a loan, you pay more than you borrowed because _____ is added.

The amount _____for a loan is called the principal.

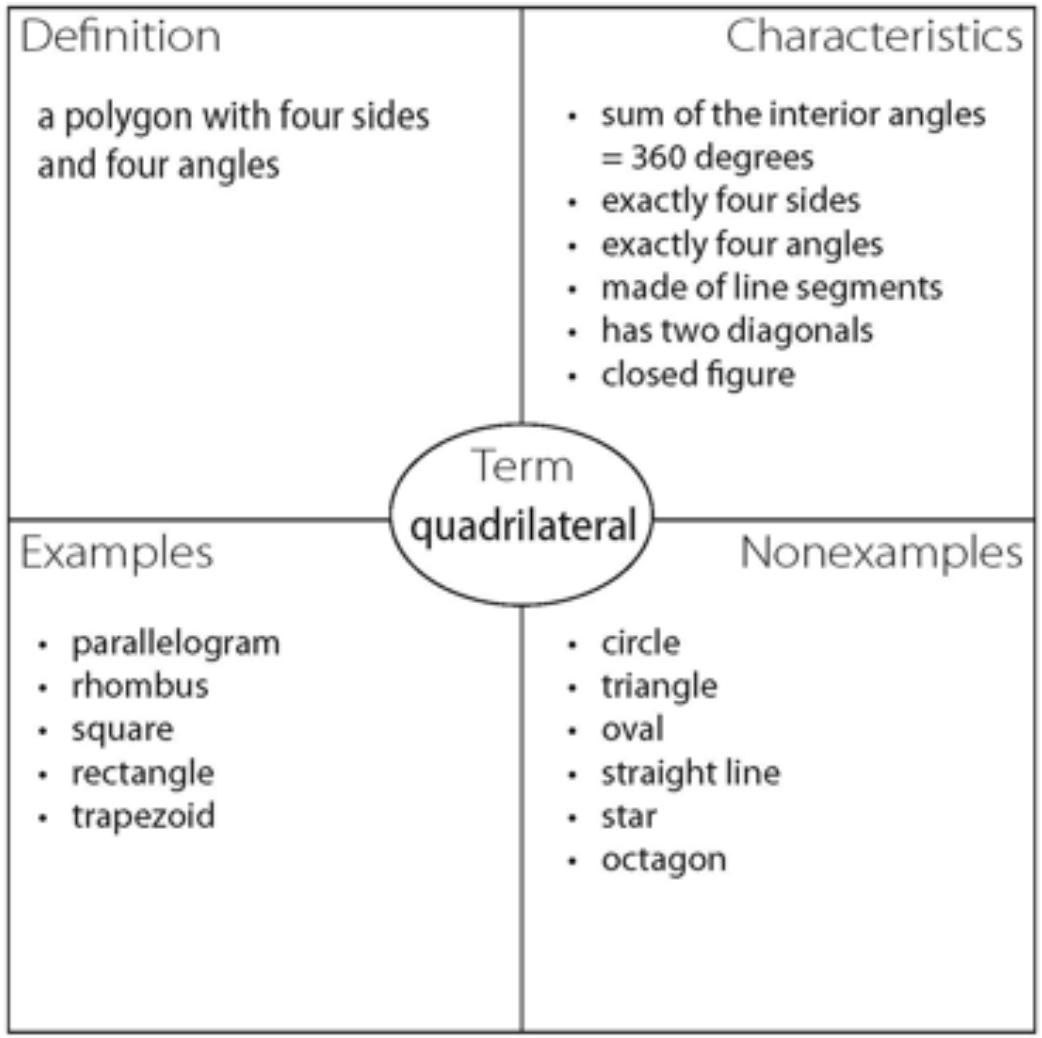
When the monthly repayment made on a loan is _____ than the interest payable, then the amount owing on the loan reduces. This is called a reducing _____ loan.

The _____ of the loan is the amount of time you get to repay the loan. If you repay more than the minimum repayment, then you will pay the loan off _____. If the interest rate increases, then either the repayment will increase, or the term of the loan will increase.

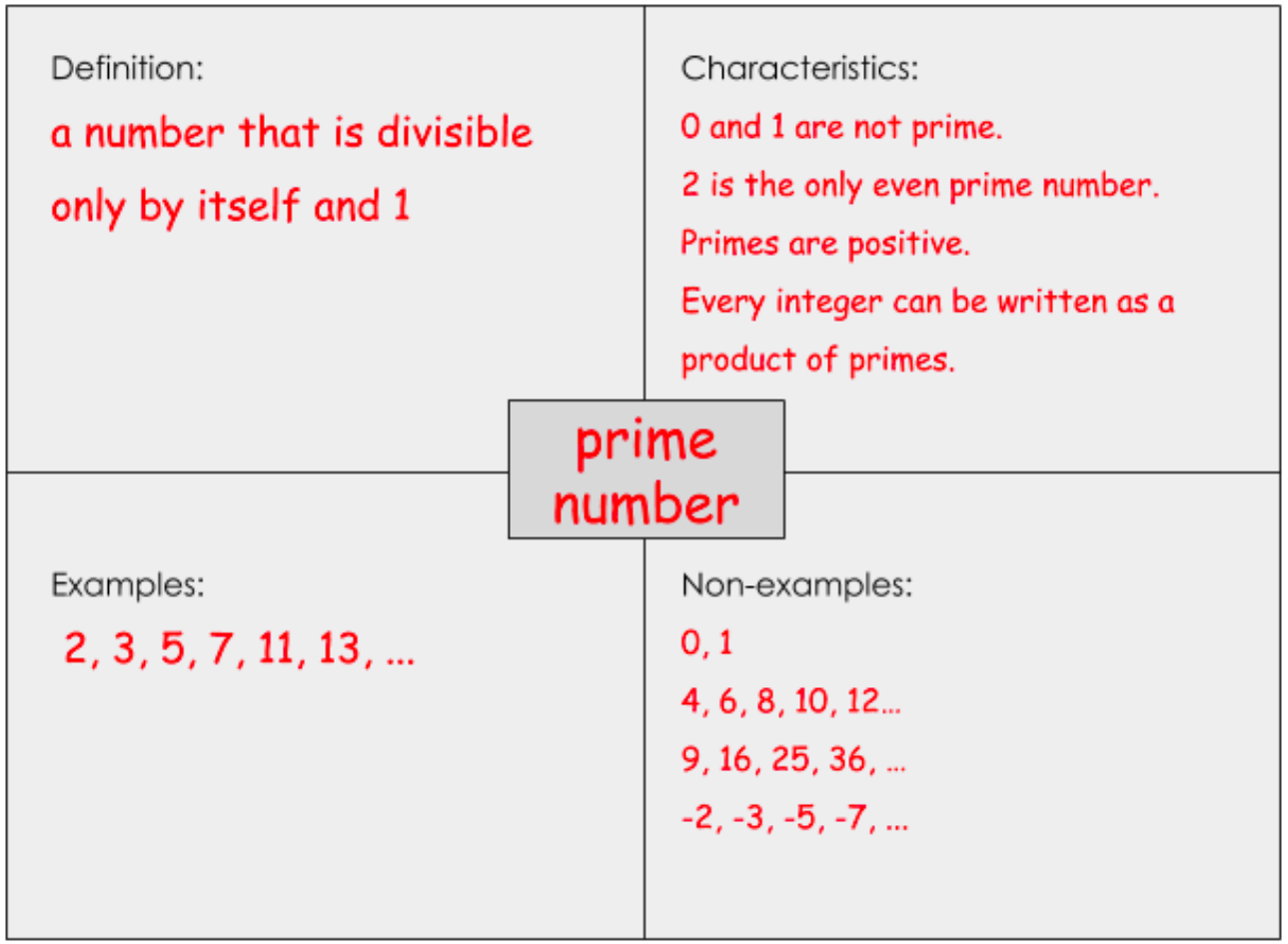
Simple interest is also called _____ interest.

An investment where interest is calculated after the previous interest has been added on to the principal is called a _____ interest loan.

Graphic Organisers: Frayer Diagrams



Frayer Model adapted from Frayer, D. A., Frederick, W. C., & Klausmeier, H. G. (1969). *A schema for testing the level of concept mastery* (Technical report No. 16). Madison, WI: University of Wisconsin Research and Development Center for Cognitive Learning.



Frayer Model for prime numbers

Graphic Organisers: KWL Charts

TOPIC: _____

K	W	L
What do you know about this topic already? Give definitions, examples, formulae, diagrams.	What do you want to know about this topic? What questions do you have?	What did you learn about this topic? Give answers to the questions you asked in the W column. Write down definitions, examples, formulae, diagrams.

Before the topic

At the end of the topic

TOPIC: Pythagoras' Theorem

K	W	L
• Pythagoras lived in Greece a long time ago and had a secret maths society. • PT has to do with right angled triangles. • The rule is $a^2 + b^2 = c^2$	• What it does • How to use it • Why do we learn it?	• I can use it to find the third side in a right angled triangle. • I need to be able to re-arrange an equation and to find squares and square roots. • I can use it to solve real life measurement problems.

Graphic Organisers: Notes to Future Self

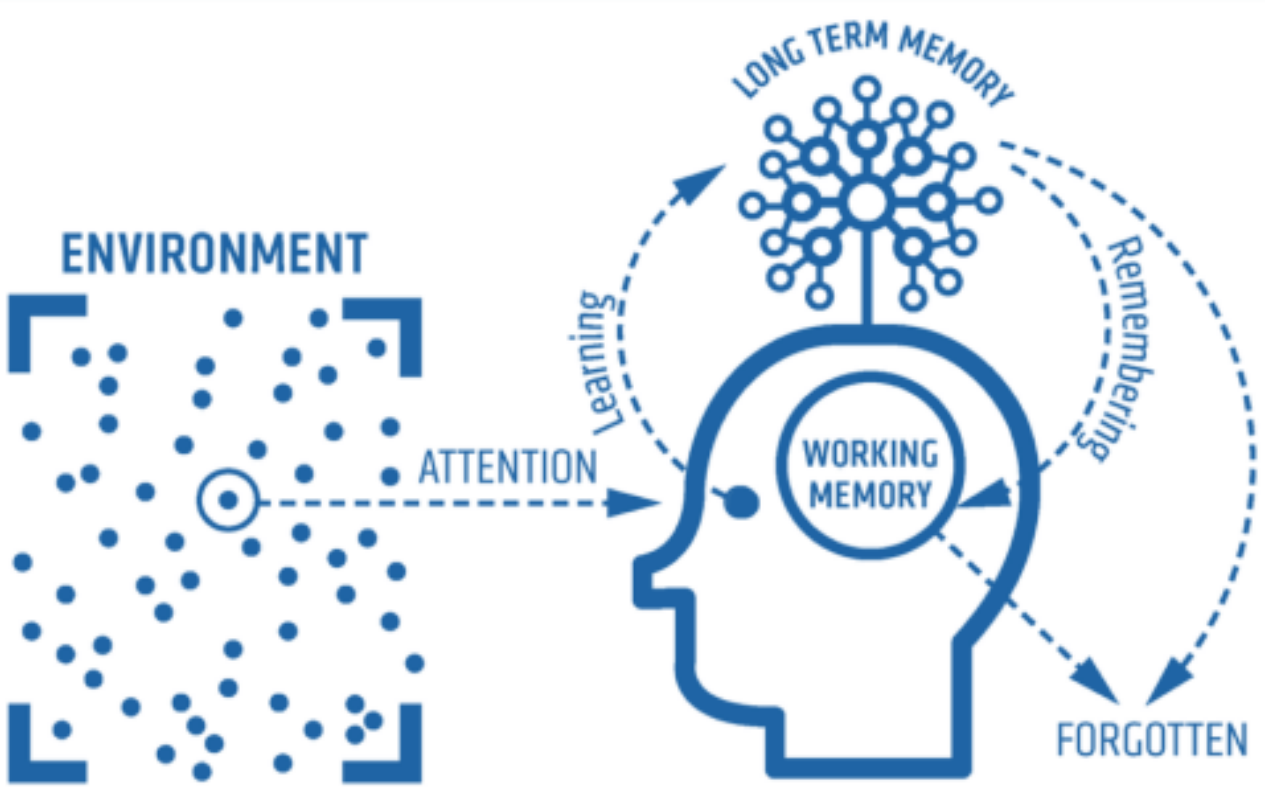
TOPIC:	
Guided example	Definitions and vocabulary
Notes to future self: Things to help you remember this 3 weeks from now.	Student's example

Other Ideas

- Find-a-words
- Anagrams
- Comprehension activities
- Literacy starters
- Taboo
- Crosswords

A Model For Learning - Schema

- Language is the key to learning
- We learn new ideas and concepts by attaching them to what we already know and understand.
- Retrieval happens when we recognise the language and can start problem solving in our working memory.



Dan Meyer

For explanations to be effective, teachers and students need a shared set of experiences to talk about.

When you approach a new unit, you can ask yourself, “what experiences do I and my students share that relate to that vocabulary?”

The answer is never “none.”

New knowledge builds on old knowledge.

Whenever your students come to know those new words, they’ll have connected them to words, images, and ideas they already had.

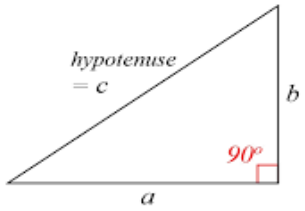
You can make that learning (and your own job!) easier by surfacing that older knowledge in advance, helping your students remember what they already know.

Trigonometry

On the Reference Sheet

Right-Angled Triangles

Pythagoras' Theorem

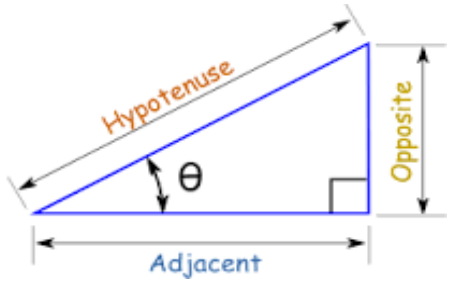


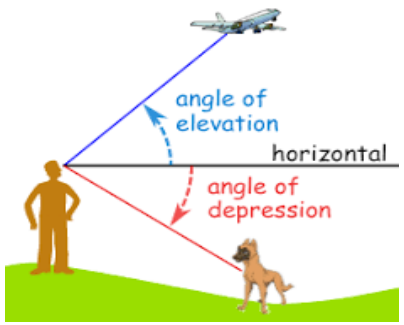
$$c^2 = a^2 + b^2$$

$$\sin\theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$$

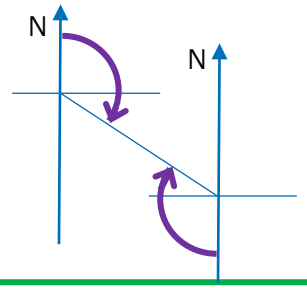
$$\cos\theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$$

$$\tan\theta = \frac{\text{Opposite}}{\text{Adjacent}}$$





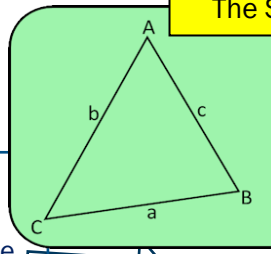
Alternate angles around parallel lines are equal.



Non-Right-Angled Triangles

Angle sum of a triangle is 180°

The Sine Rule

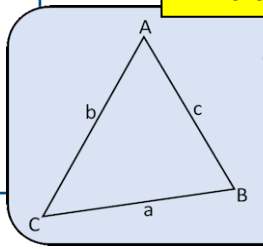


$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

or

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

The Cosine Rule

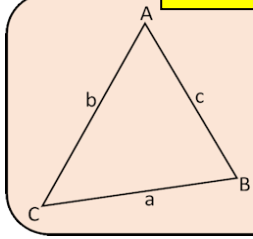


$$a^2 = b^2 + c^2 - 2bc\cos A$$

or

$$A = \cos^{-1}\left(\frac{b^2 + c^2 - a^2}{2bc}\right)$$

The Area Rule



$$\text{Triangle area} = \frac{1}{2}ab\sin C$$

Degrees and Minutes

$31^o 42' = 32^o$ to the nearest minute

$31^o 07' = 31^o$ to the nearest minute

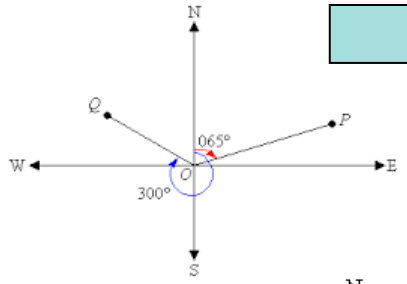
$1^o = 60'$

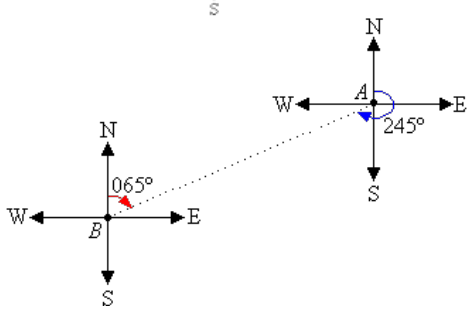
1 degree = 60 minutes

Use the DMS button on calculator

Bearings

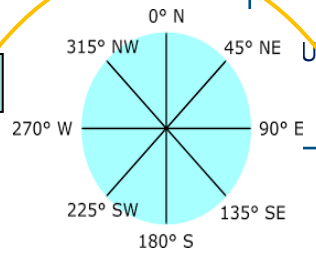
True Bearings are a 3-digit angle measured clockwise from North.



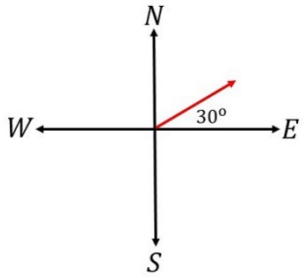


B is on a bearing of 245° **from** *A*.

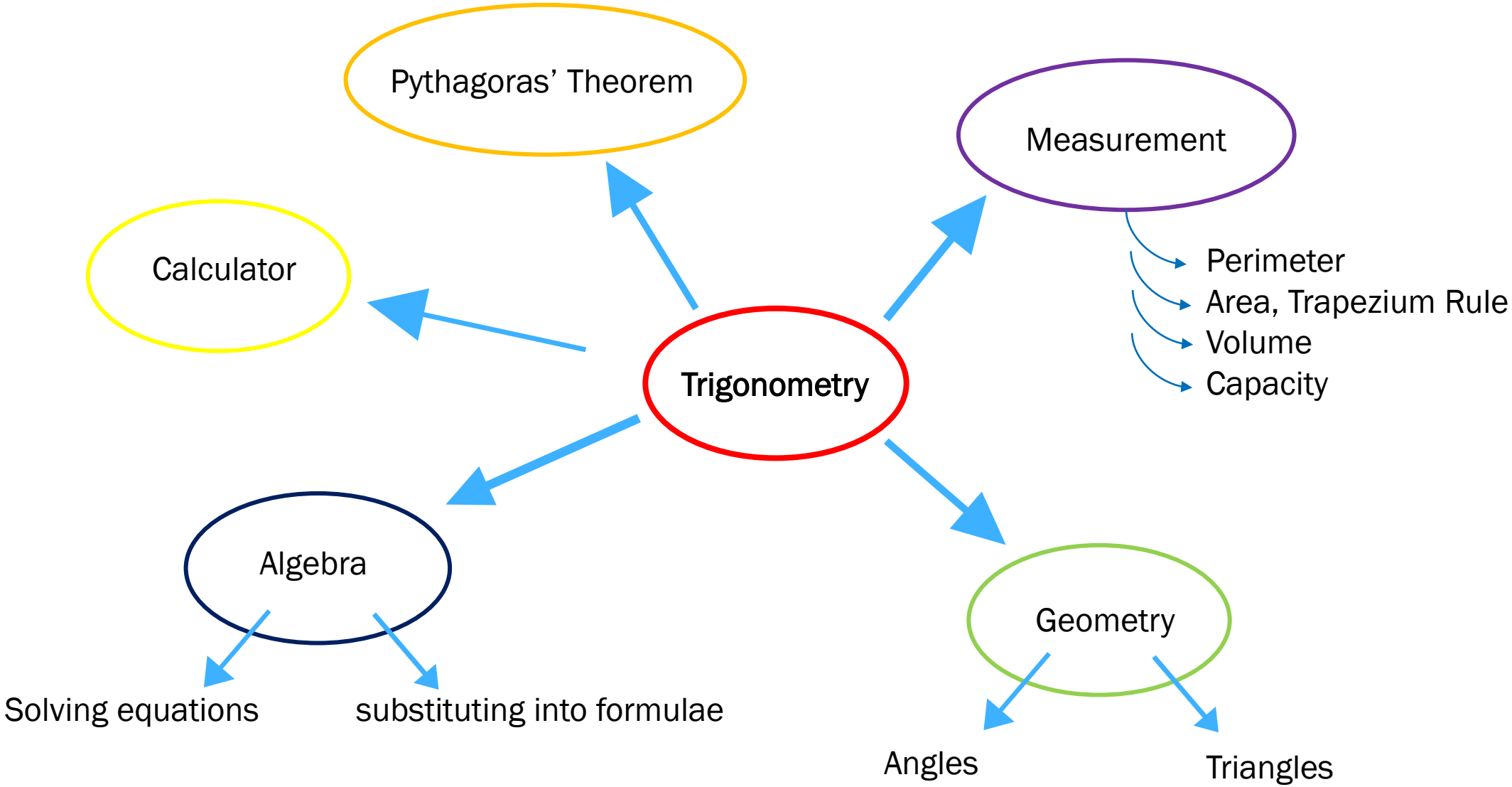
A is on a bearing of 065° **from** *B*.



Compass Bearings measure the angle from either North or South, then the angle East or West.

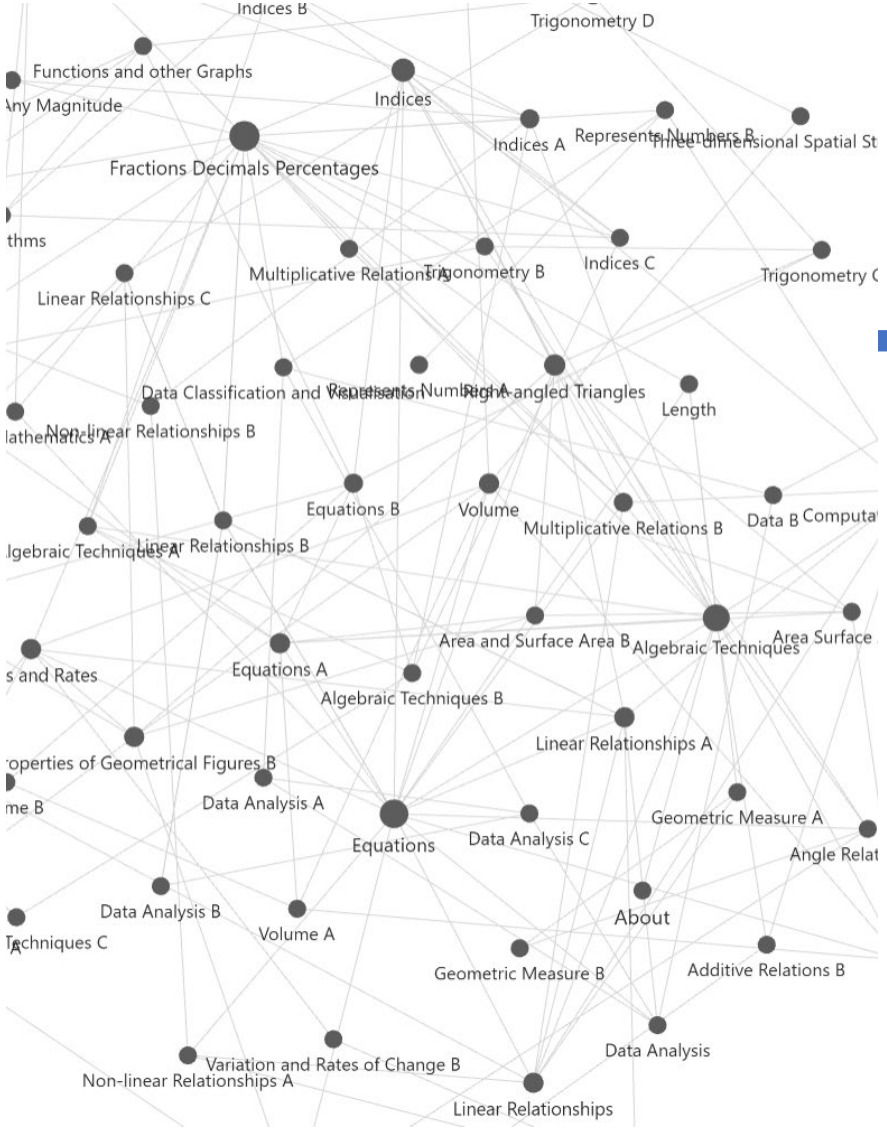


This is a bearing of N60°E



Making Connections – Jo Boaler

https://youtu.be/7FE_8wGgw_M



Making Connections

https://publish.obsidian.md/mrdingmaths/About

2024 Professional Learning

- **Planning and Programming for the New Mathematics 7-10 Syllabus**
  19 March, 10 April
- **Writing Assessment Questions for the Stage 6 Calculus Courses**
  28 March, 19 November
- **Assessment for the New Course Performance Descriptors** 3 May, 25 June
- **Aboriginal and Torres Strait Islander Perspectives in Mathematics**
  13 June
- **Assessing Common Content** 23 May
- **How To Teach Maths Without a Textbook** 31 May, 29 July
- **Making Connections in Stage 5 Algebra** 18 September
- **Working Mathematically in the New 7-10 Syllabus** Online anytime
- **Mathematics Heads of Department Conference** 23 August Ascham School

Developing students' Literacy Skills in Mathematics 7-12

Thank you for your participation today.

jwoods@aisnsw.edu.au