Hobart

Day 3
Working memory and Maths Anxiety
Problem Solving and Bar Modelling

Overview

Morning session – Working Memory and Maths Anxiety

Afternoon session- Bar modelling and Problem Solving

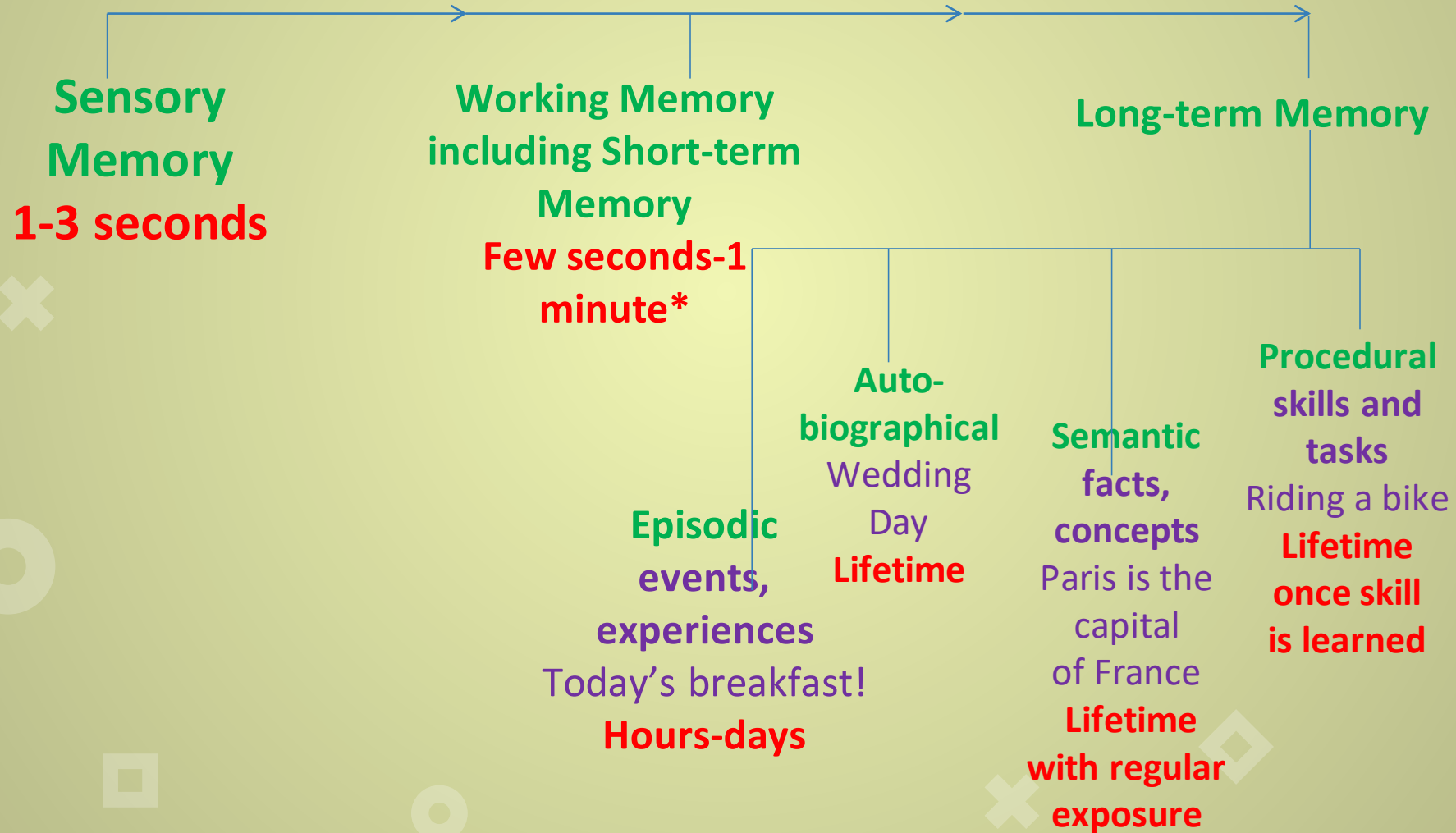# Memory

How complex is our memory system?

Purposes of working memory

Sub systems of working memory

Impact of working memory on learning

Strategies to help

Memory

Sensory Memory

1-3 seconds

Working Memory including Short-term Memory

Few seconds-1 minute*

Long-term Memory

Episodic events, experiences

Today's breakfast!

Hours-days

Auto-biographical

Wedding Day

Lifetime

Semantic facts, concepts

Paris is the capital of France

Lifetime with regular exposure

Procedural skills and tasks

Riding a bike

Lifetime once skill is learned

Short-term Memory

Short-term Memory is part of the Working Memory system. It comprises:

- Visuo-spatial memory
- Verbal memory

Used for **storing material without manipulating it** mentally, or doing something else at the same time

- e.g. remembering a telephone number uses **verbal** short-term memory.
- e.g. picking out a top to match the skirt you just bought uses **visuo-spatial** memory
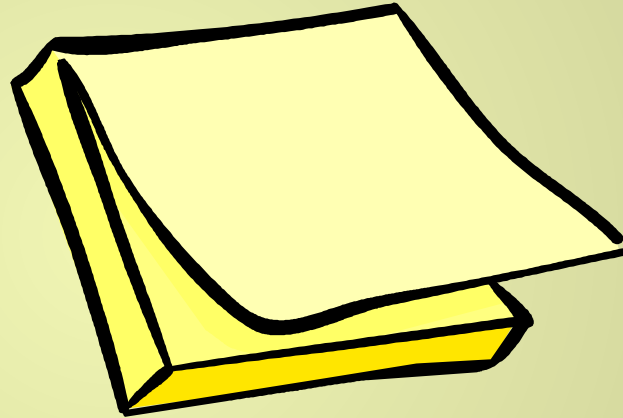
Long Term Memory

Permanent Storehouse

A system for permanently storing, managing, and retrieving information for later and ongoing use. Items of information stored as long-term memory may be available for a lifetime.

Information which has been registered, encoded, rehearsed, and stored for future retrieval; Material and information retained in LTM underlies cognitive abilities.

Working Memory

Welcome to the 2-minute, 4-unit jotting pad!

'A mental workspace to BOTH hold AND manipulate information in the mind.'

e.g. 43 x 67 (without pen, paper or calculators).

Working Memory : 5 Main Purposes

1. Holding an Idea in mind while developing, elaborating, clarifying or using it

2. Recalling information from long term memory while holding related information in short term memory

Working Memory : 5 Main Purposes

3. Holding the components of a task together in memory while completing the task

4. Keeping a series of pieces of information together so that they remain meaningful

5. Holding a long term plan while thinking about a short term need – Starting with the End in Mind

The Theories of Capacity and Time Decay

Working Memory problems can be divided into:

1. Capacity

2. Time

Sub Systems of Working Memory

1. Phonological Loop

2. Visual-Spatial Sketchpad

3. Central Executive

Fig. 1 Baddeley & Hitch's (1974) working memory model.

Measuring phonological loop

Digit span

Rapid naming

Dyslexics have a great problem with this but are ok with visual and central executive

Visuospatial sketchpad

To do with colour , shape and form

Storage and manipulation of spatial and visual information

Stores form and colour information

Stores spatial/movement information

Dyslexics are generally ok with this.

Explaining Dyslexia

The working memory is a bi-directional system

So if the phonological loop is a problem then it does not work properly with the central executive.

The central executive ends up doing the work of the phonological loop making it less efficient

Explaining dyslexia

The visuospatial sketch pad works well with the central executive so they don't compete with each other

This explains why dyslexics can see the 'Big Picture'

Explaining Dyscalculia

The working memory is a bi-directional system

So if the visuo-spatial sketch pad is a problem then it does not work properly with the central executive.

The central executive ends up doing the work of the sketch pad making it less efficient

Implications

Difficulty in visualising maths

Difficulty in understanding visual representations in maths

Difficulty in setting out maths on paper

How does memory affect learning?

Impairment of sensory organs will prevent information from registering in memory

STM and WM- have limited capacity- like a shelf- put too much on and something will fall off.

Size of memory is not indicative of intelligence

70% of children with reading difficulties have poor working memory capacity

How To Manage Poor Working Memory Intervention 3 Ms

How can I make it **manageable**?

How can I make it **multisensory**?

What **memory aids** can be used?

The 3 M's

Make it manageable

Look for patterns in and/or chunk series

Word for short periods

Read what you need to read

Plan written work

Use technology

The 3 M's

Make it multi-sensory

Use videos and CD Roms

Lists, wall charts

Talk and discuss

Role play

Colour code

Do

The 3 M's

Make use of memory aids

Notes

Record

Review/summing up

Visual imagery

Logic

Judy Hornigold

How to make things more memorable

Registration

Rehearsal

Attended to

Connection

Primacy and recency

Unusual

Assessing Working Memory
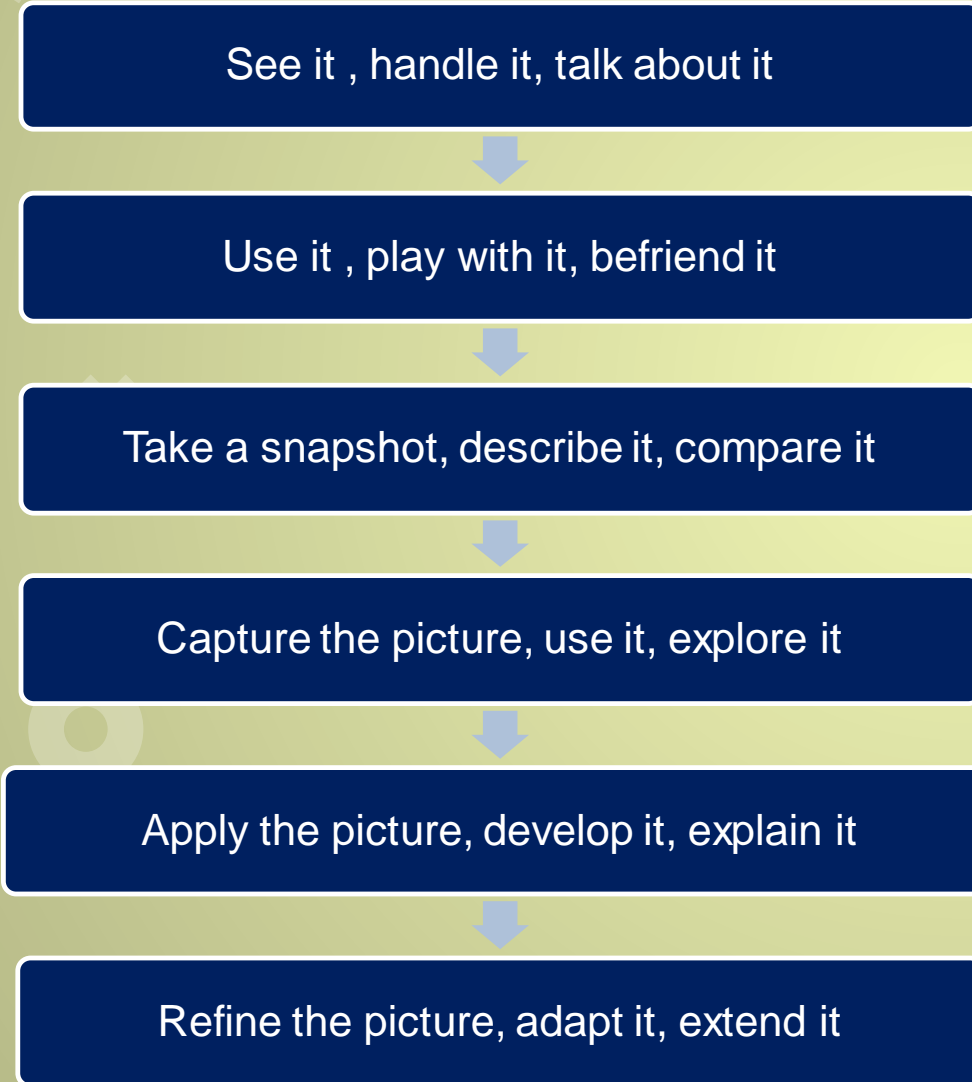
Digit Span Test

PHAB Semantic test

TOMAL 2

Strategies to support memory in Maths

Visualisation

Generalisation

Concrete Pictorial Abstract

Progression in Visualisation

See it , handle it, talk about it

Use it , play with it, befriend it

Take a snapshot, describe it, compare it

Capture the picture, use it, explore it

Apply the picture, develop it, explain it

Refine the picture, adapt it, extend it

Concrete

Abstract

How to teach visualisation

It starts to develop through play before school

Use concrete materials : Children need texture to connect to the brain

Boys versus Girls? (Ramful and Lowrie 2015)

Mediate- Can you imagine?
Can you picture ?
Can you see a 6 hiding in a 10?
Are you sure?

Generalisation: Key facts and Derived facts

Consider our money system

1p, 2p, 5p and 10p

Why have we chosen these amounts?

Derived Facts

72 students aged 7 – 13 years were tested on addition
Of those that achieved an above average score
   9% counted on
   30% known facts
   61% derived facts

Of those that achieved a below average score:
   72% counted on
   22% counted all
   6% known facts
   0% derived facts

Gray and Tall. 1994. University of Warwick

Supporting Working Memory using ICT
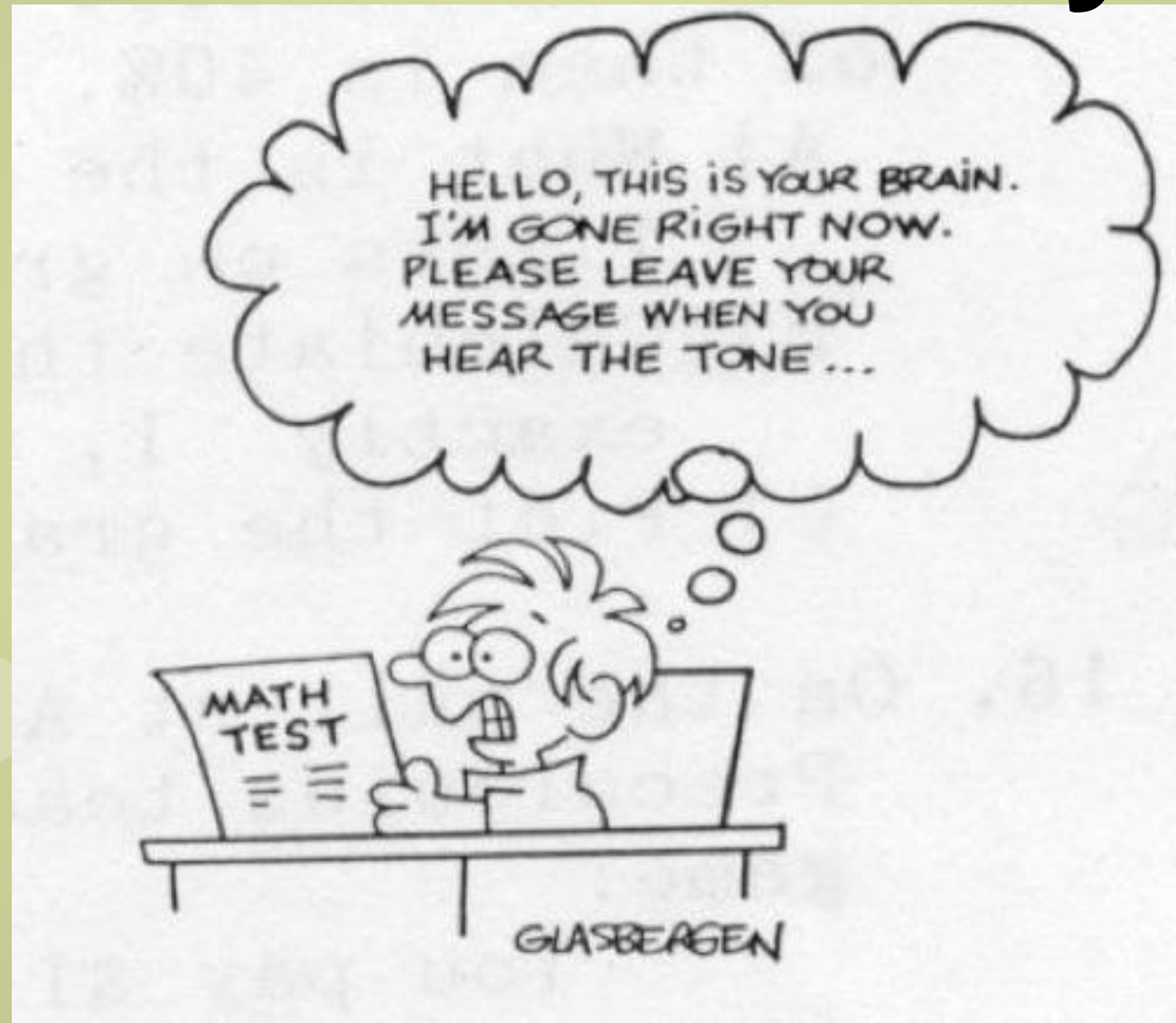
There are some software programs to develop working memory.

Memorise

Memory Booster (Lucid).

Mastering Memory (CALSC).

Jungle Memory (www.junglememory.com)

Cogmed https://www.cogmed.com

Maths Anxiety

Maths Anxiety
Preis & Biggs (2001)

Phase 1 - Negative feelings towards maths

Phase 2 - Avoidance of maths

Phase 3 - Poor maths preparations

Phase 4 - Poor maths performance

Anxiety - last difficulty to occur as it is a consequence of the preceding problems, yet it is the first difficulty to overcome.

Maths anxiety can be caused by:
Maths at speed

Learning facts, procedures without understanding them

Struggling with the language of maths.(Chinn, 2012)

How to overcome maths anxiety

Techniques

Foster the idea that mistakes are good

Don't emphasise speed in Maths

Spend time developing number sense at an early age

Use concrete manipulatives in a way that develops understanding

(Singapore Maths)

Techniques to overcome Maths anxiety

Writing down your worries- based on Emotion Regulation Theory (Klein and Boals 2001)

Reappraisal of anxiety- Beltzer, Nock, Peter and Jamieson (2014)

Deep breathing/Slow breathing

Imagining Safe place

Humour

David Sheffield , University of Derby

Bar Modelling

When solving word problems, it is often not the calculation that children can't do – rather they are not sure which calculation they need to do.

(NCETM, 2013)

What is the Bar Model?

The bar model exposes the relationships within the structure of the mathematics. It is used to find the unknown elements in the context of part/part/ whole relationships. This supports the development of algebraic thinking.
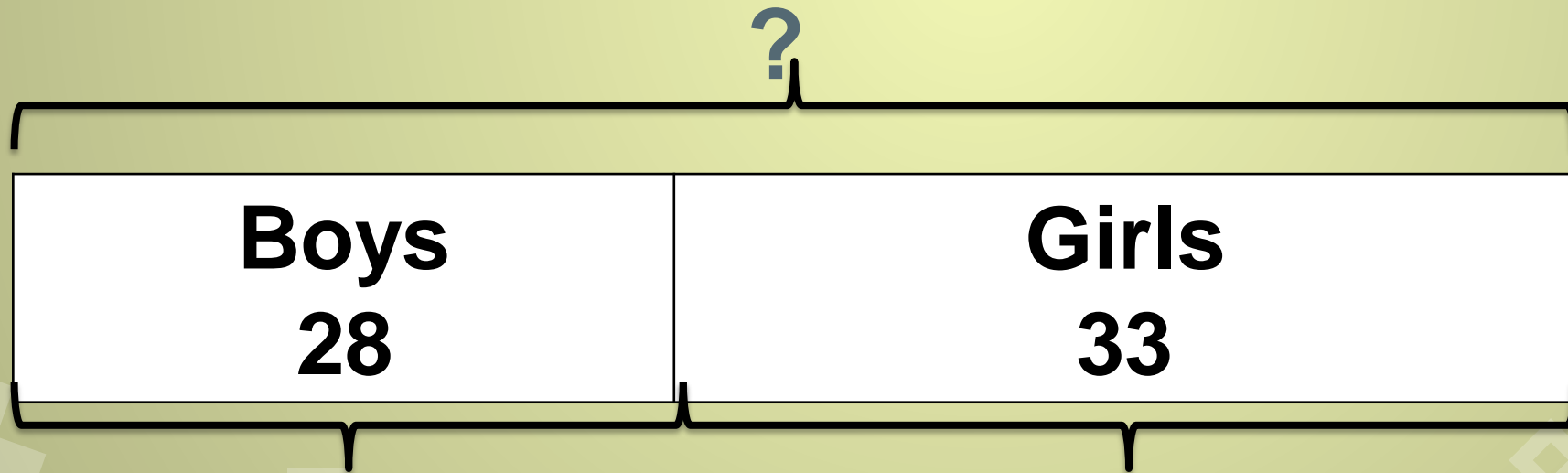
Whole	
Part	Part

Types of Bar Model

Part/Part Whole model

Comparison Model

Before and After Model

Part Whole Model for Addition and Subtraction

28 boys and 33 girls were at the school party. How many children were there altogether

In this case we know both parts and need to find the whole

?

| Boys 28 | Girls 33 |

Part Whole Model for Multiplication and Division

For this model we need to know two of three pieces of information

The size of one unit or part

How many parts

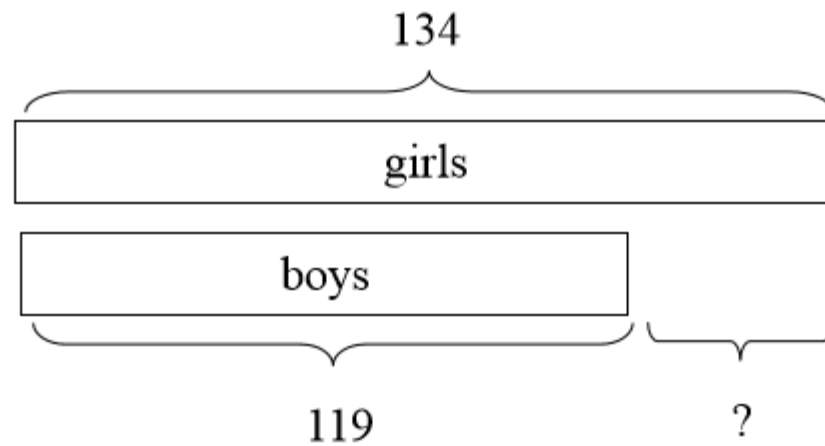What the whole is

Part Whole Multiplication and Division

Consider this problem

Sam saved £5 per week for 6 weeks. How much did he save altogether?

What information do we know? What do we need to find out?

Comparison Model

We could also know the two parts and find out the difference between them

Key points of the comparison model

We need to know what our unit part is

We need to know what the difference is between the parts

Comparison Models

Additive Comparison

John has 3 more shells than Kim. Together they have 15 shells. How many shells does John have?

(one quantity is a certain amount more or less than another)

Multiplicative Comparison

Larry has 3 times as much money as Mary. Together that have £120. How much money does Larry have?

(one quantity is a certain number of times another)

Larry and Mary Problem

Larry has 3 times as much money as Mary. Together that have £120. How much money does Larry have?

Common Misconception

Do we need to divide 120 by 3 ?

Do we need to divide 120 by 4? Why?

Four Groups Problem

There are four groups of students in the hall. In each group there are twice as many boys as girls.

In group A there are 12 girls. How many boys are there in group A?

In group B there are 12 boys. How many students are there in group B?

In group C there are 12 students . How many girls are there in group C?

In group D there are 12 more boys than girls. How many students are there in group D?

Ben's savings

Ben spent 1/5 of his savings on a gift and ½ of the remainder on a book. The book cost £12. How much were Ben's savings?

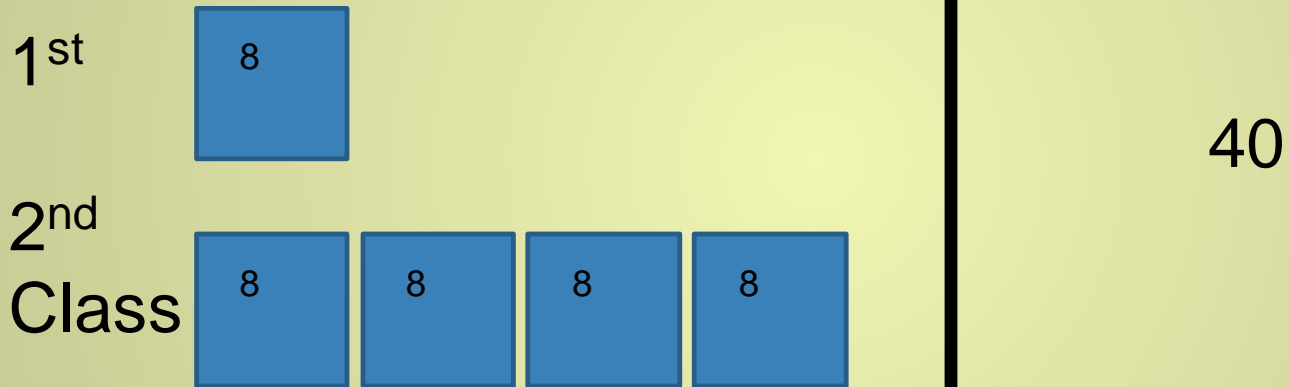Ralph posts 40 letters, some of which are first class, and some are second.

He posts four times as many second class letters as first.

How many of each class of letter does he post?

40 letters
He posts four times as many second class letters as first.
How many of each class of letter does he post?
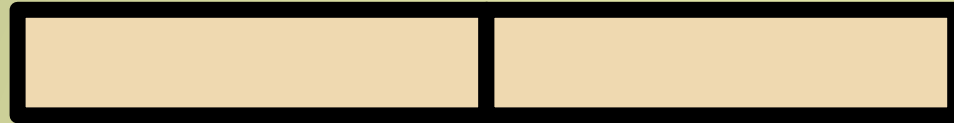
1st [8]

40

2nd
Class [8] [8] [8] [8]

40 ÷ 5 = 8
8 x 4 = 32
1st Class 8 letters
2nd Class 32 letters

Ratio

Tim

Sally

Tim and Sally share marbles in the ratio of 2:3
If Sally has 36 marbles, how many are there altogether?

Before and After Problem

Sam had 5 times as many marbles as Tom. If Sam gives 26 marbles to Tom, the two friends will have exactly the same amount.
How many marbles do they have altogether?

Heuristics

Heuristics refers to the different strategies that we can adopt to solve unfamiliar or non-routine Maths problems.

How Do We Use Heuristics In Problem Solving?

There are different types of heuristics and they can be grouped into four categories, based on how they are being used:

To give a representation

To make a calculated guess

To go through a process

To change the problem

Heuristics

To give a representation	To make a calculated guess	To go through the process	To change the problem
• Draw a diagram/bar model • Make a list • Use equations	• Guess and check • Look for patterns • Make suppositions	• Act it out • Work backwards • Before-after	• Restate the problem • Simplify the problem • Solve part of the problem

Example

Question:
At a café, there are 3-legged stools and 4-legged stools for customers to sit on.
Vincent counts 15 stools with a total of 50 legs altogether.
How many 3-legged stools are there in the café?

Step 1: Understanding The Problem

Understand it before you try to solve it

Break it into smaller parts

Guided questions to draw out important information

Step 2: Deciding On An Approach

Which of the four heuristics would be suitable here?

Step 3: Solving The Problem

Use the selected approach to solve the problem
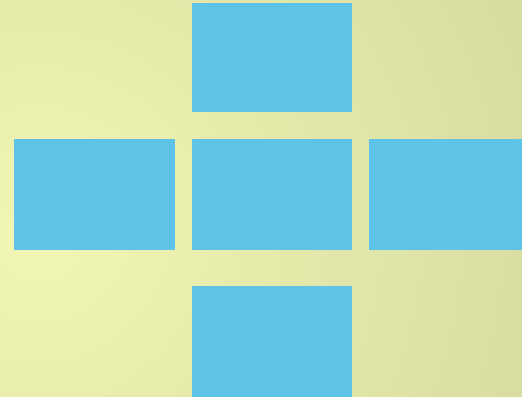
Step 4: Checking The Solution

Refer back to the question

Have you solved the problem?

Are you sure you are correct?

Work in groups

① Place the cards on the boxes

② Arrange so the sum of the horizontal numbers is equal to the sum of the vertical number

MATHS
NO PROBLEM!

Identifying Patterns and Relationships

Jay writes his name in the following way:

J A Y J A Y J A Y J A Y....?

1st 2nd 3rd   100th?

What letter is in the 100th position?

Think

Look for a pattern

JAY is repeated after every 3 letters or as a group of 3 letters

Solve by using multiples of 3

Deduction

Example

Three classmates Leo, Mandy and Noah, live in the same apartment building. They live on different floors: floor 4, floor 6 and floor 7. To meet his classmates on their floors, Leo has to take the elevator down. Noah lives on the floor between Leo and Mandy. On which floor does each student live?

Draw a diagram/ model

Example

A rectangular block of wood, 20 cm by 18 cm by 9cm is cut into many 3 cm cubes. What is the maximum number of 3 cm cubes that can be cut out?

Think

Draw a block 20cm by 18cm by 9cm

Draw 3cm cubes inside

Solve using the diagram

Look for a pattern

Example

Simone used some square blocks to build the figures shown below. How many square blocks does she need to build figure 6?

Think

Study the figures to look for a pattern

Draw a table and fill in the data

Use the table to find the solution

Square block pattern
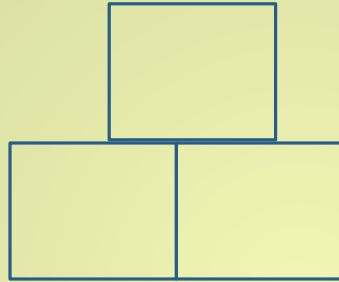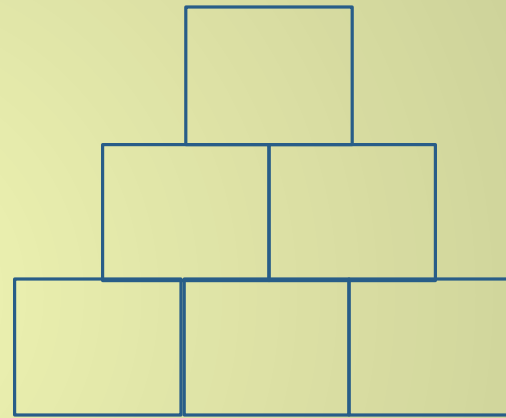

Fig 1   Fig 2   Fig 3

Make a list/table

Example

Mrs Toma bought some stickers for her students. If she gave each student 4 stickers, she would be 1 sticker short. If she gave each student 3 stickers , she would have 8 stickers left. How many students did she have altogether?

Think

Data given: 4 stickers= 1 short (multiple of 4 less 1)

3 stickers = 8 left (multiple of 3 plus 8)

List the multiples of 3 and 4 and find the common number

Guess and Check

Example

Lucy was reading a book and stopped at two facing pages. The product of the 2 page numbers was 156, what were the page numbers?

Think

The two facing pages must have consecutive numbers. With a product = 156

Any Questions?