Reasoning:
The ♥□ of mathematics

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What is Teaching?

Creating a
common experience
to reflect on
and so bring about learning.

Maths is NOT a spectator sport

Tea party

On Saturday some friends came to tea.

We shared a packet of biscuits.

On Sunday I had another tea party.

More friends came round and we shared the same number of biscuits.

Did each person on Sunday eat more, less or the same as each did on Saturday?

Biscuits / Friends	Fewer	Same	More
Fewer			
Same			
More		Less	

Biscuits / Friends	Fewer	Same	More
Fewer		More	More
Same	Less	Same	More
More	Less	Less	

Mathematical reasoning

- In 7 out of 9 cases you can find the answer **without knowing any quantities**

- Mathematical reasoning is largely independent of arithmetical ability

Biscuits
Friends

$\dfrac{5}{8}$ $\dfrac{7}{8}$ $\dfrac{5}{6}$ $\dfrac{5}{8}$

$\dfrac{5}{9}$ $\dfrac{7}{8}$ $\dfrac{5}{6}$ $\dfrac{4}{7}$

Which is larger?

$\dfrac{29}{30}$ or $\dfrac{30}{31}$

Which is closer to 1?

$\dfrac{29}{30}$ or $\dfrac{30}{31}$

Types of mathematical reasoning

Inductive

- Generate examples, 'sniff out' patterns

Deductive

- Draw conclusions based on known facts

Analogical

- Identify and draw on similarities with things already understood

Relational

- Identify connections between quantities or shapes that do not require numbers or measures

Inductive

- Write down a two-digit number.
- Add the two digits in your number.
- Subtract that sum from the two-digit number.

- Do this for at least 3 different two-digit numbers.

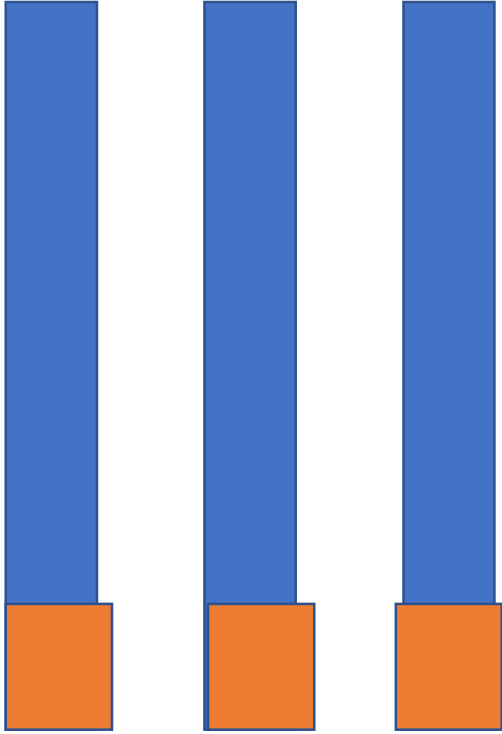- Share your answers with others nearby.

- What do you notice?

Why your mind needs
your body much more
than it thinks

GUY CLAXTON

INTELLIGENCE
IN THE
FLESH

One of the major errors of twentieth-century psychology was to suppose that there are childish ways of knowing which are outgrown, and ought to be transcended, as one grows up. The childish ones are the bodily ones, and are to do with concrete action and experience. The grown-up ones are abstract, logical and propositional. But it is a Cartesian mistake to think that, once you have mastered logic you don't need the body anymore. … We should think of the developing mind as a tree that grows new branches, not as a spaceship whose booster rockets fall away for ever one they have done their job and are spent.

Claxton, 2015, p 165-66

Deductive

True or false?

All semi-circles are half of a circle.
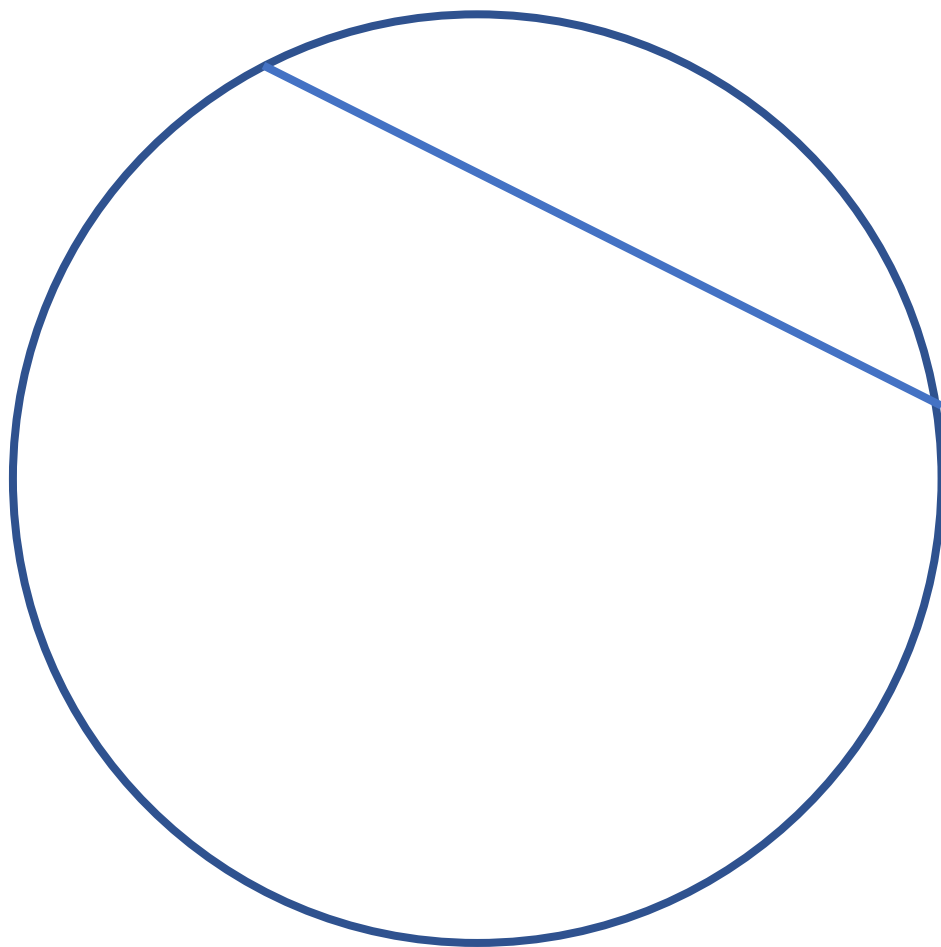
Deductive

True or false?

All semi-circles are half of a circle.

All halves of a circle are semi-circles.

Relational

Sue and Julie are cycling equally fast around a track.

Sue started first.

When Sue had cycled 9 laps,
Julie had cycled 3 laps.

When Julie completed 15 laps, how many laps had Sue cycled?

Analogical

A mathematical answer to 27 divided by 6 is
4 remainder 3.

Make up a real world problem that involves 27
divided by 6 but where it makes sense to round
the answer up to 5.

Types of mathematical reasoning

Inductive

Deductive

Analogical

Relational

- Children, from an early age, engage with all these types of reasoning.

- They are not easy to separate.

- We can help children learn more about mathematical reasoning.

Reasoning and arithmetic

- Relational reasoning comes **before** arithmetic

- Children can engage in mathematical reasoning from the beginning of school

Development of Maths Capabilities and Confidence in Primary School

Terezinha Nunes, Peter Bryant, Kathy Sylva and Rossana Barros
Department of Education,
University of Oxford

In collaboration with ALSPAC, University of Bristol

department for
children, schools and families

DCSF-RR118

Mathematical reasoning, even more so than children's knowledge of arithmetic, is important for children's later achievement in mathematics.

Nunes et al. DSFC RR-118

National Curriculum Aims

The national curriculum for mathematics aims to ensure that all pupils:

- become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.

National Curriculum Aims

The national curriculum for mathematics aims to ensure that all pupils:

- **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language

National Curriculum Aims

The national curriculum for mathematics aims to ensure that all pupils:

- can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.
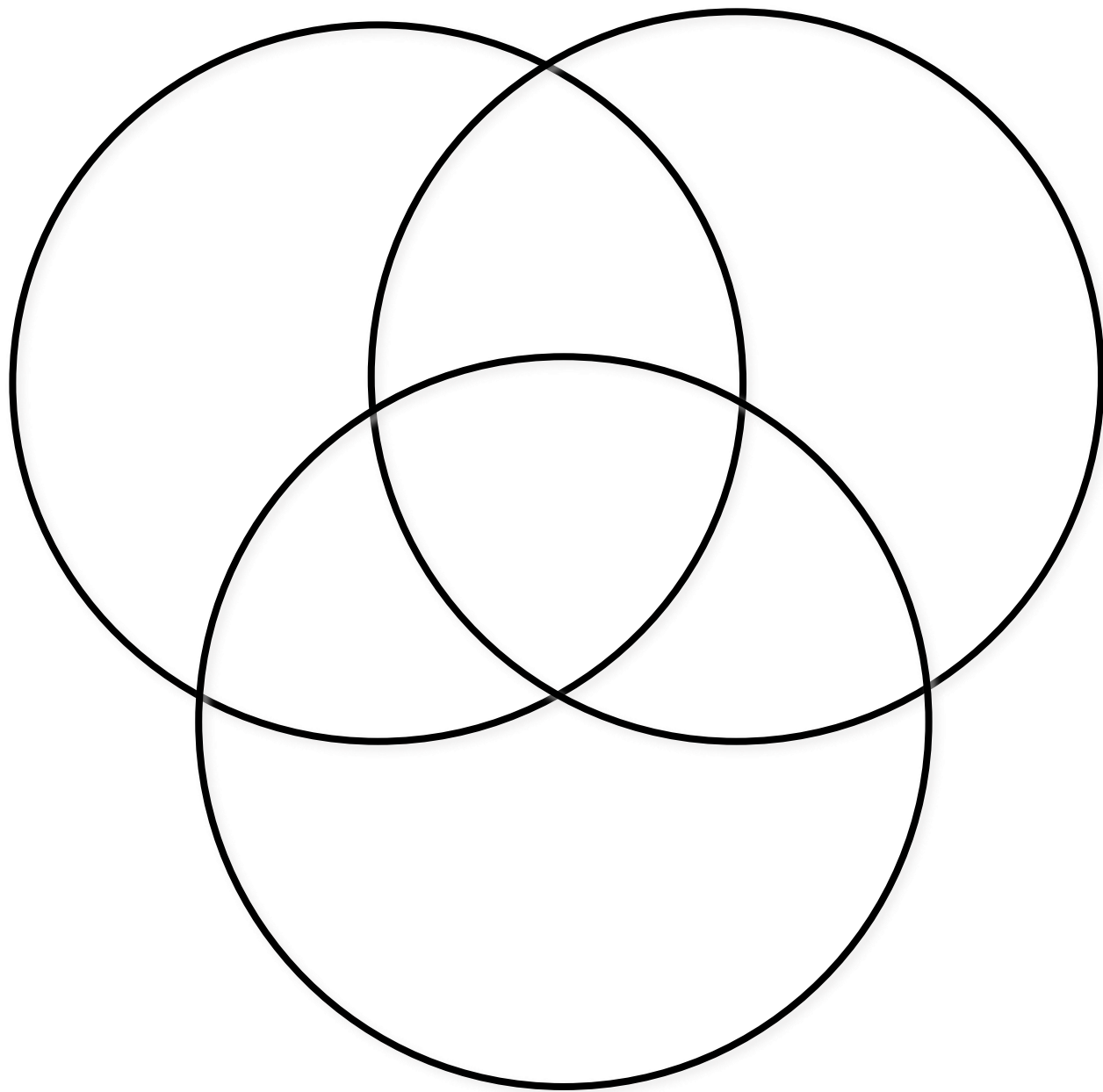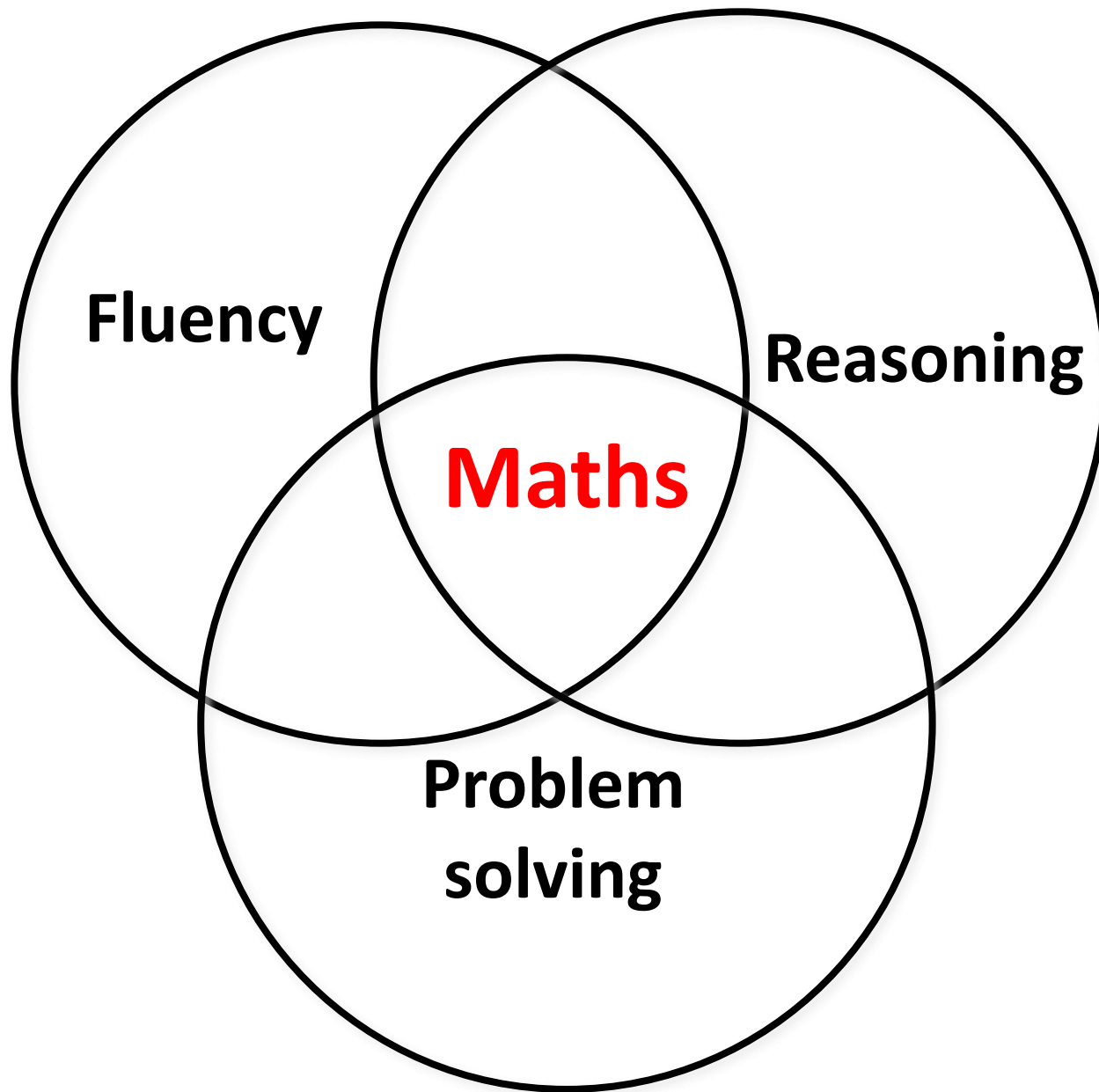
Reasoning routines
True or False?

True or false?

20 + 8 = 10 + 18

20 + 8 = 19 + 9

80 + 8 = 60 + 18

8 + 90 = 40 + 50 + 8

True or false?

- 37 + 56 = 56 + 37

- 37 + 56 = 38 + 59

- 37 + 56 = 36 + 57

True or false

- 37 + 56 − 56 = 37

- 458 + 347 − 347 = 458

- 458 + 347 − 347 = 347

Conjecture

If you add a number and then take the same number away, you have the number you started with.

True or false?

- 56 − 38 = 56 − 37 − 1

- 56 − 38 = 56 − 39 + 1

- 56 − 38 = 56 − 36 − t

True or false?

- 3 x 5 = 5 x 3

- 3 x 5 = 3 x 4 + 5

- 3 x 6 = 3 x 5 + 3

True or false?

- 26 x 39 = 39 x 26

- 26 x 39 = 26 x 40 − 26

- 26 x 40 = 26 x 39 + 26

True or false?

TRUE: 5,542 ÷ 17 = 326

- 326 ÷ 17 = 5,542
- 5,542 ÷ 326 = 17
- 17 x 326 = 5,542
- 326 x 16 = 5,542 − 16
- 18 x 326 = 17 x 326 + 326

21

$$5{,}542 \div 17 = 326$$

Explain how you can use this fact to find the answer to **18 × 326**
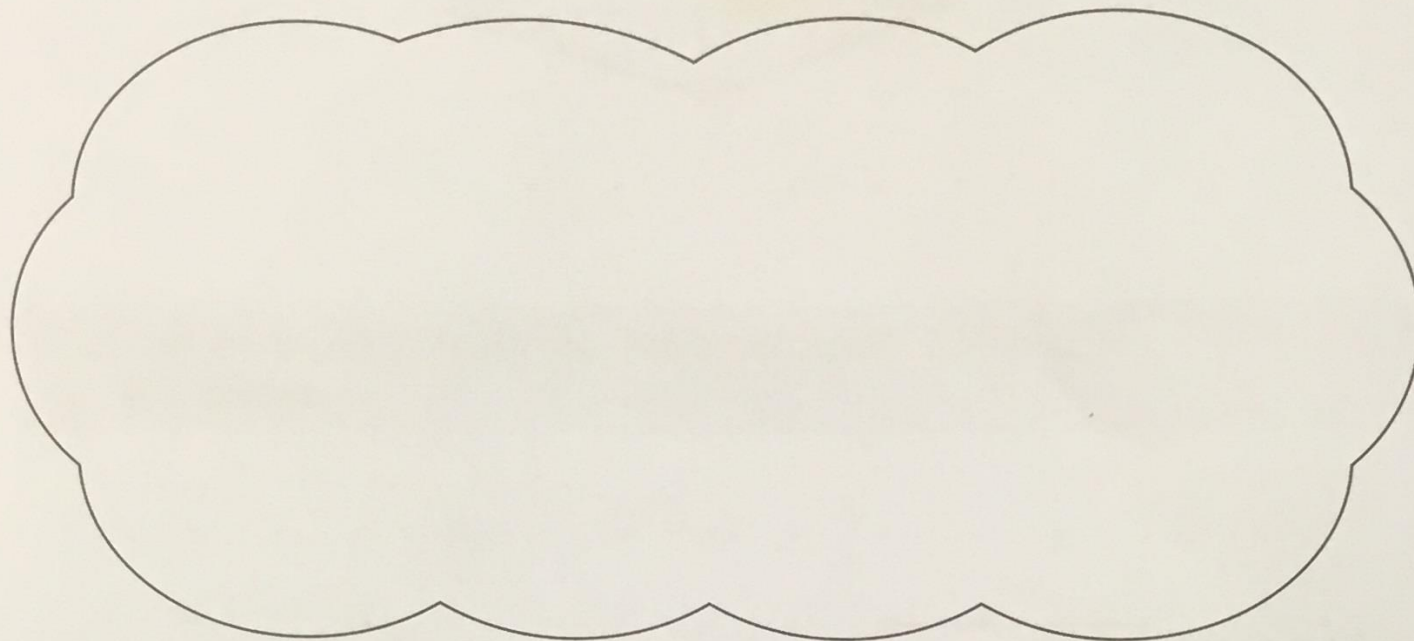
1 mark

Thank you
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