2017 Annual Conference Royal Holloway 7-9th April

Mathematical Association

Fluency through games and investigations

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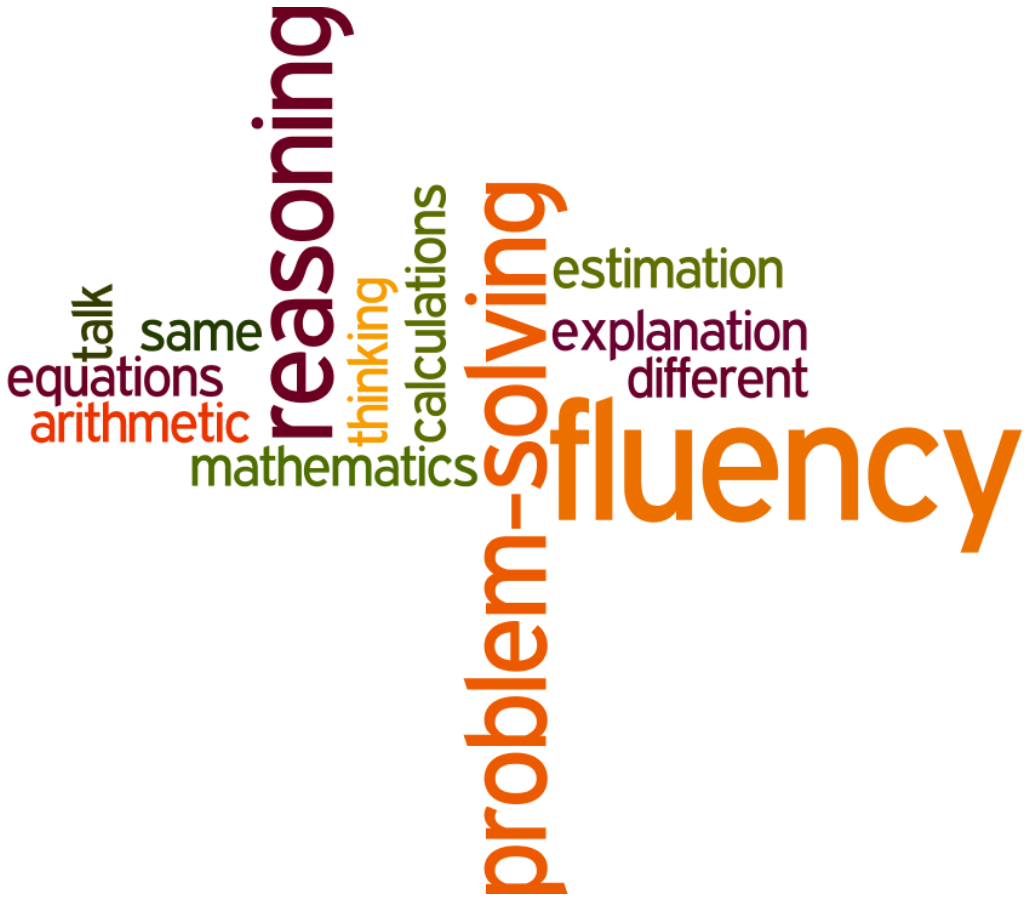
Common denominators: connections within and beyond maths



Aims

- To explore what fluency is
- To look at some ways of promoting fluency in the primary classroom

Fluency

- What is fluency?
- What does it mean to be fluent?
- What are the common denominators?

Number sense

- “Man, even in the lower stages of development. Possesses a faculty which, for want of a better name, I shall call *number sense*. This faculty permits him to recognise that something has changed in a small collection when, without his direct knowledge, an object has been removed or added to a collection.”

(Tobias Dantzig, 1954, Number, the language of Science)

(Keith Devlin, 2001, p.21)

Number sense

- “a person’s general understanding of number and operations along with the ability and inclination to use this understanding in flexible ways to make mathematical judgements and to develop useful strategies for handling numbers and operations.”

(McIntosh, Reys and Reys,1992, p3)

A flexible solver

- “someone who: (a) has knowledge of multiple solution procedures, and (b) has the capacity to invent or innovate to create new procedures.”

(Star and Seifert, 2006, p282)

Fluency without fear

- Teachers across the US and the UK ask students to memorize multiplication facts, and sometimes addition and subtraction facts too, usually because curriculum standards have specified that students need to be "fluent with numbers". Parish, drawing from Fosnot and Dolk (2001) defines fluency as 'knowing how a number can be composed and decomposed and using that information to be flexible and efficient with solving problems.' (Parish 2014, p 159).
- Whether or not we believe that fluency requires more than the recall of math facts, research evidence points in one direction: The **best way to develop fluency with numbers is to develop number sense and to work with numbers in different ways,** not to blindly memorize without number sense.

How do our learners become fluent?

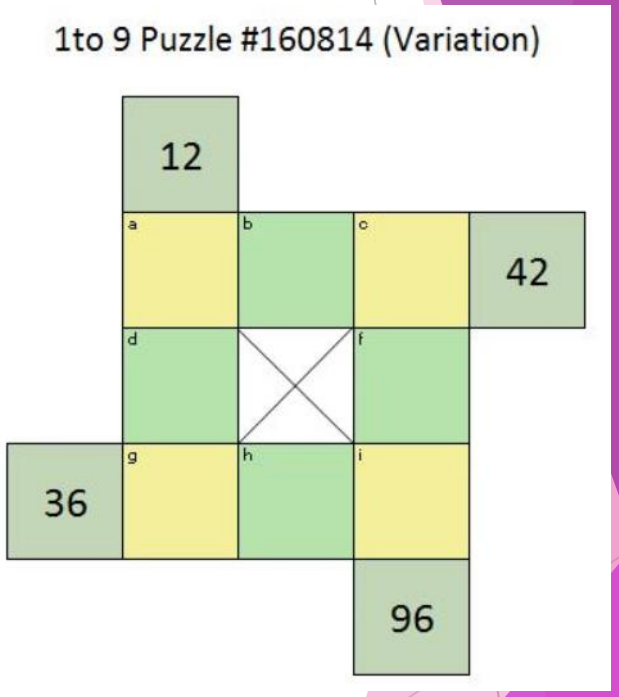
- Manipulatives
- Talking about their work
- Consolidation in meaningful contexts

(Nrich article by Lynne McCure

http://nrich.maths.org/10624 accessed on 15th February 2017)

Activities – Four operations

- Youcubed Make 100 (mult and a bit of adding/sub)
- 1 to 9 puzzles (multiplying)
- Nrich – Four go – bit like strike it out
- Square number n x n and (n + 1) x (n – 1) is n x n -1
- Grade 4 games – Amazing functions



Four go Nrich

Stage: 2 ★

Draw a number line on a piece of paper, marked from 0 to 20, like this:

This challenge is a game for two players. The first player chooses two numbers in this grid and either multiplies or divides them.

100	25	5
10	2	36
12	4	3

÷

×

Square numbers and near squares

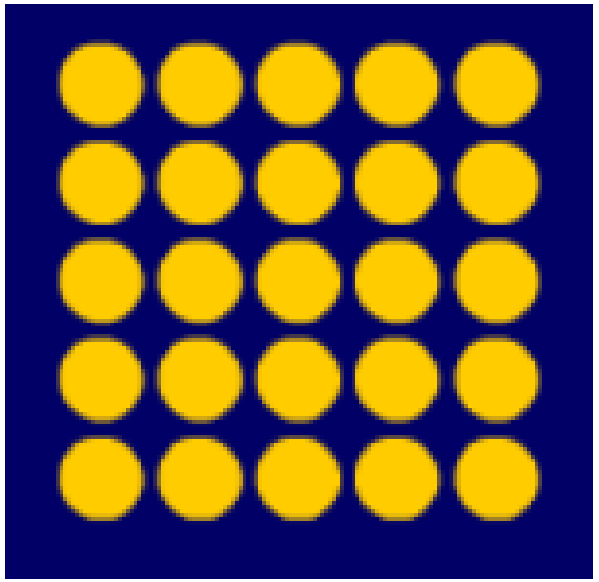
- Take a number and square it – write it down.

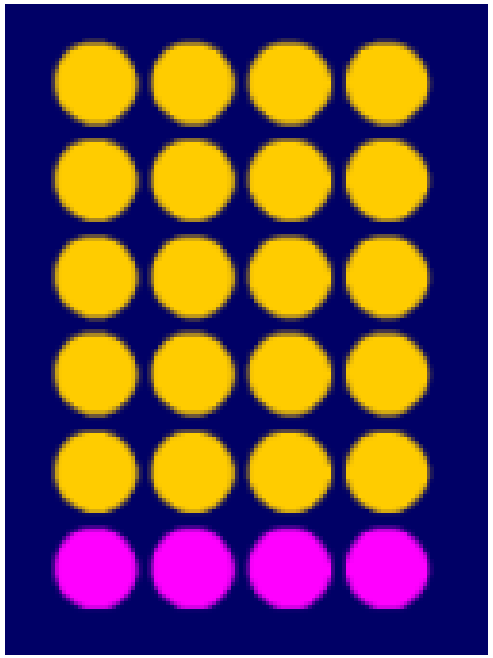
e.g. 5 so 5 x 5 = 25

- Now multiply the numbers either side of this number:

e.g. 4 x 6 = 24

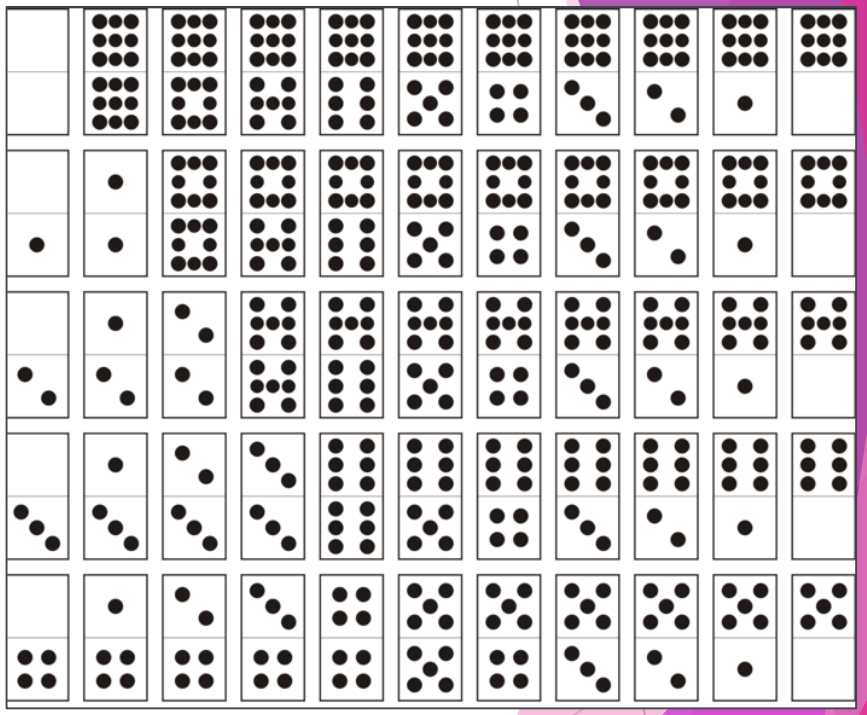
- Investigate for other starting numbers. What do you notice?
- Can you explain why this happens?



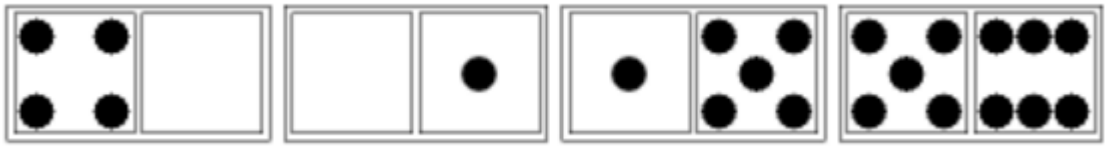


“Dominoes” – Fives and threes

- Give out 5 dominoes to each player. Play in groups of 2,3,4. Leave rest in a pile.
- Decide who starts or highest double lays their piece out first.
- Points are scored when the dominoes at the ends of the chain add up to a multiple of 5 or a multiple of 3. Divide the total on the ends by 5 or 3 and add the answer to the player’s score. If the end total is divisible by both 5 and 3 then you score both, so for the end total of 15 you score 8 points.



Nrich – Dominoes (fives and threes explanation)

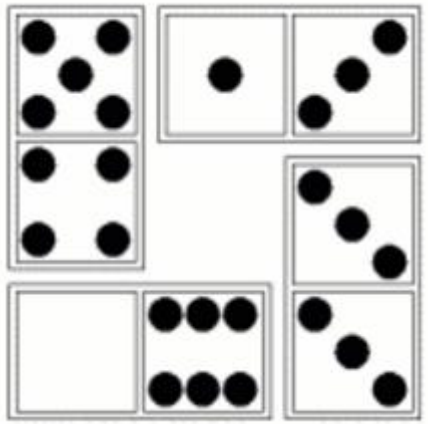


- In this example the (1,5) domino starts, scoring 2 points as the total of the ends is 6 and can be divided by 3 twice.
- Then the (0, 1) domino scores 1 point because the ends add up to 5.
- Then the (4,0) domino makes the ends add up to 9 so it scores 3 points.
- Finally the (5,6) domino makes the end total 10 scoring 2 points.

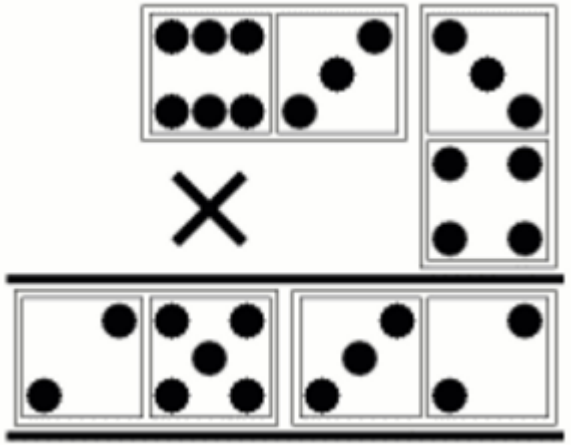
https://nrich.maths.org/1200

Nrich games – Windows and Multiplication

The spots on each side total nine. Can you make seven windows like this using all 28 dominoes so that each window has the same spot-sum for each side? One window need not have the same spot-sum as another.



Windows



Multiplication

Here you have four dominoes laid out in the pattern of a multiplication sum. Can you make seven multiplication sums like this using all 28 dominoes? Again, like 'Windows' this organises the dominoes into seven sets of four.

Amy’s dominoes – Nrich Stage 2 **

Amy has a box containing ordinary domino pieces but she does not think it is a complete set.
She has 24 dominoes in her box and there are 125 spots on them altogether.
Which of her domino pieces are missing?

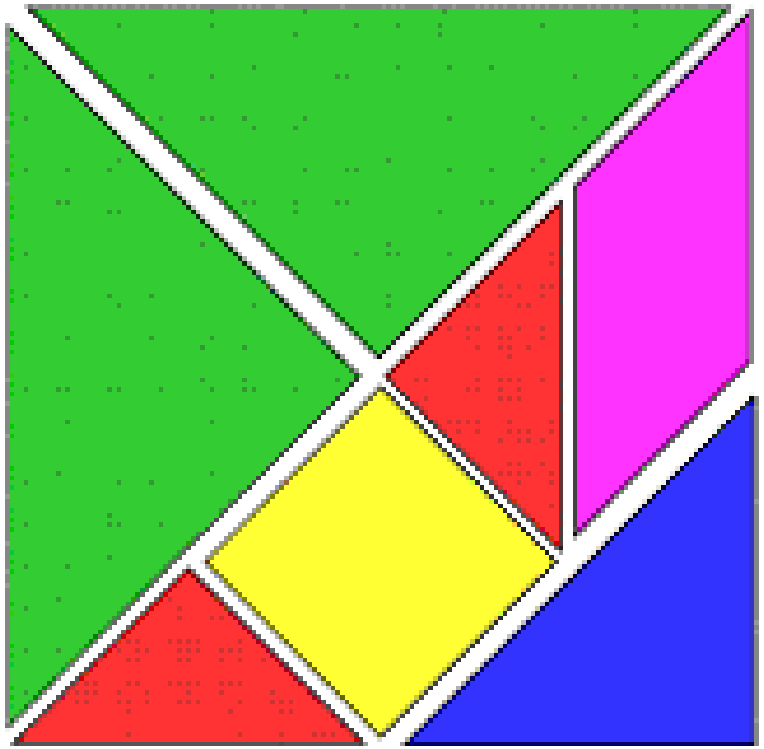
Dominoes (KS1)

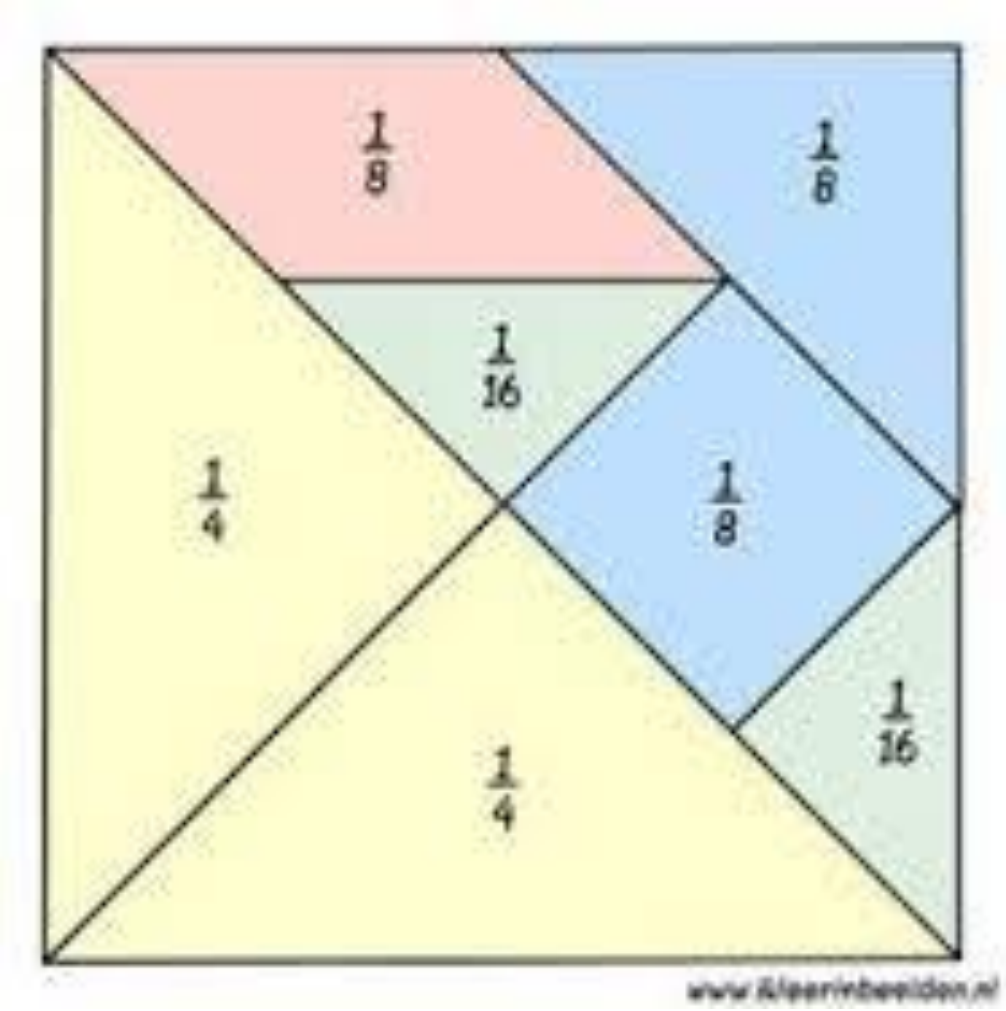
- Domino sorting
- Domino pick
- Next domino

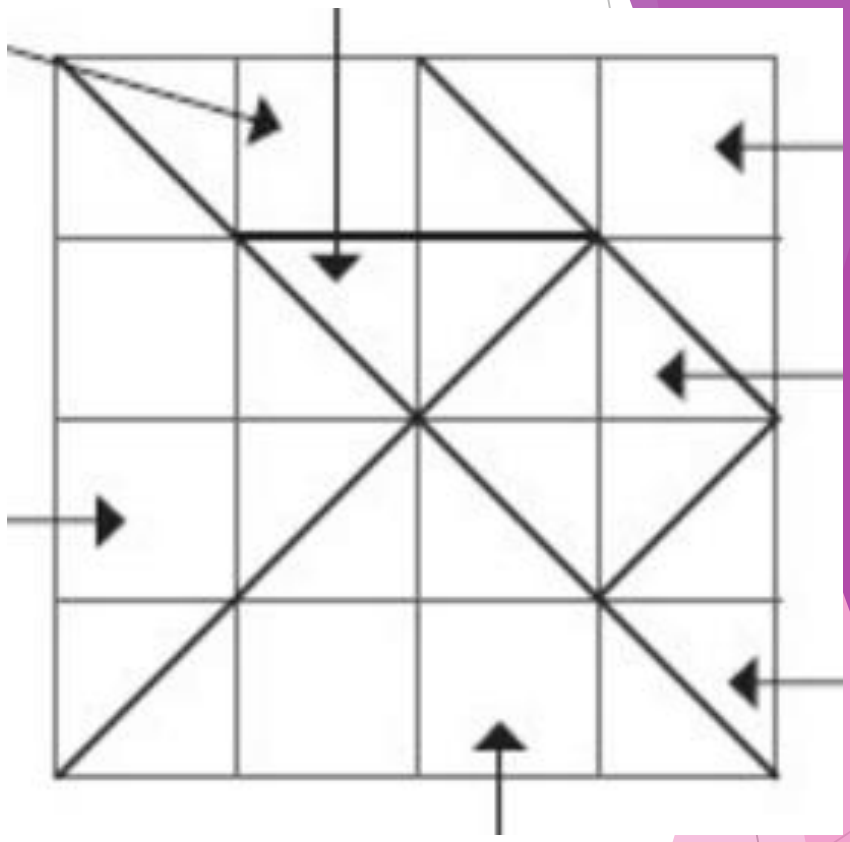
Fraction games

- Grade 5 – parts of a whole
- Compare with Cuisenaire rods and laminated cards Y5 lesson
- Fractions and tangrams
- Propeller games (fractions)

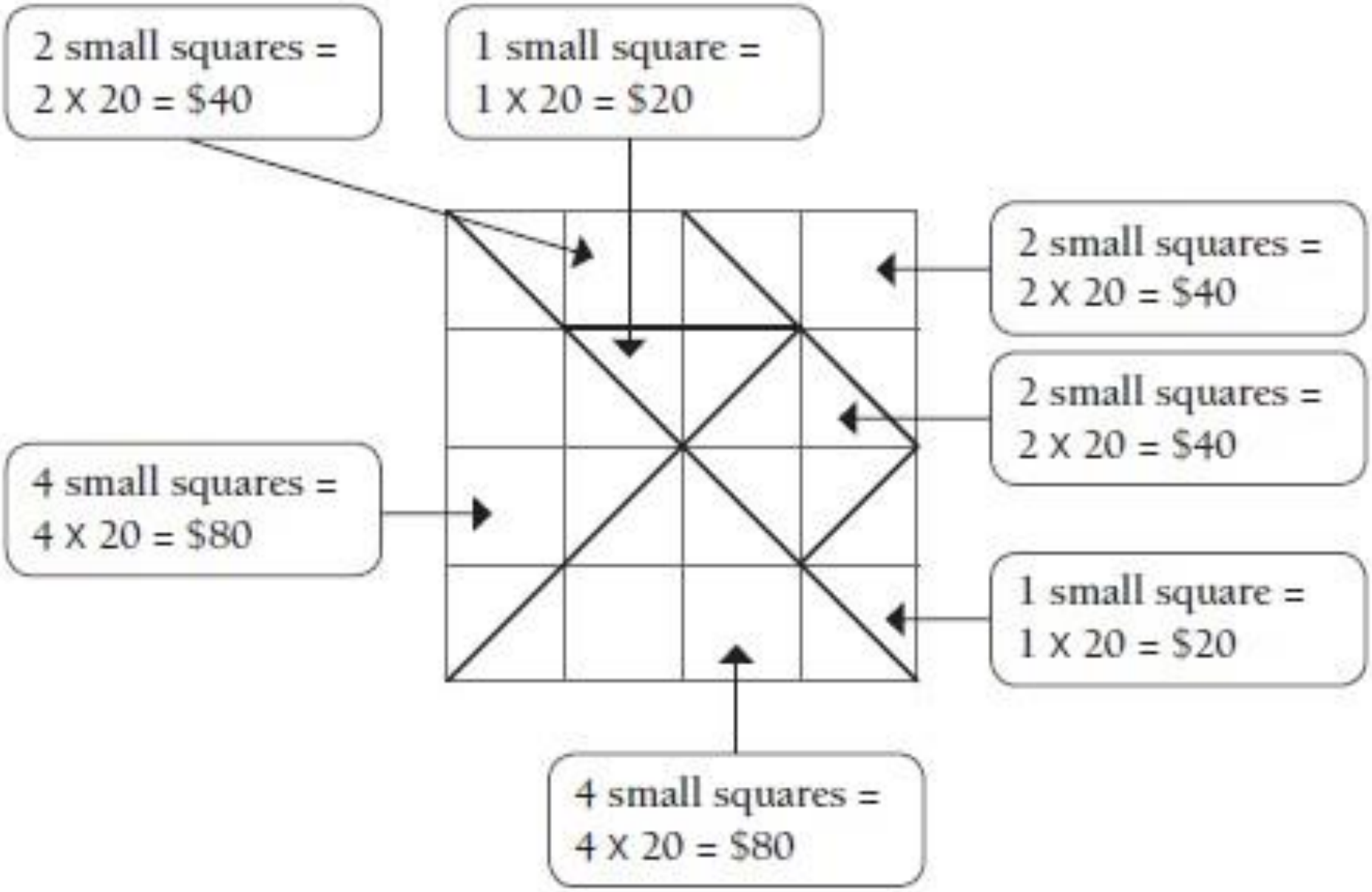
What fraction is red? yellow?







- How much is each piece worth if a small square on this grid is worth £20?


2 small squares =
2 x 20 = $40
1 small square =
1 x 20 = $20
2 small squares =
2 x 20 = $40
2 small squares =
2 x 20 = $40
4 small squares =
4 x 20 = $80
1 small square =
1 x 20 = $20
4 small squares =
4 x 20 = $80

Geometric fluency

- Stringy quads

Aims

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- To look at some ways of promoting fluency in the primary classroom

References

- Devlin, K. (2001). The Maths Gene, Phoenix
- Mcintosh, A., Reys, B. J., and Reys, R. E. (1992). A proposed framework for examining basic number sense. For the Learning of Mathematics, 12(3), pp. 2-44.

Conclusion

- It’s important to try out the ideas and adapt where necessary (dimensions of variation)
- Thank you for your engagement.

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Link to dropbox

- https://www.dropbox.com/sh/58i9equzhpm42gs/AADCKuT6loNHHv-wqHBwK9tsa?dl=0