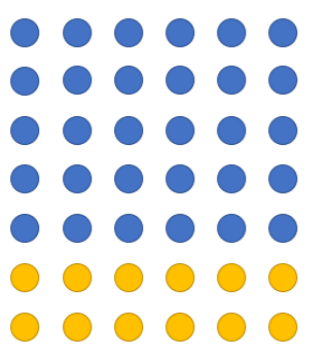


# Progression in Reasoning: Multiplication

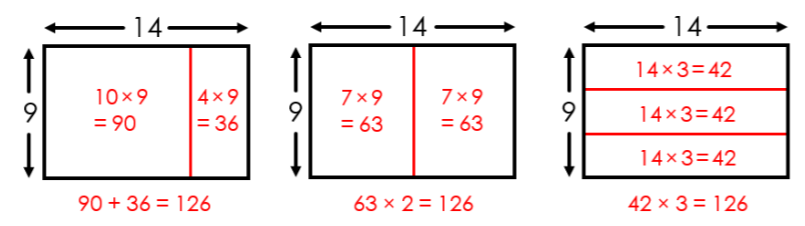
I know... so...

$6 \times 5 = 30$   
 $6 \times 7 = 42$

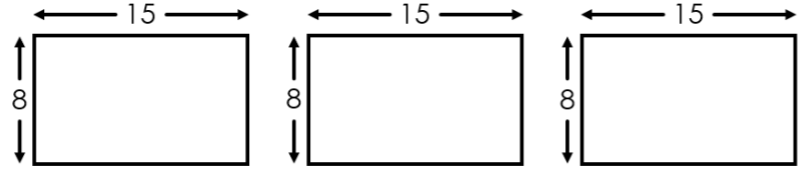
$6 \times 5 = 30$



Different Ways



Find 3 ways to calculate  $15 \times 8$ :



I know... so...

$17 \times 6 = 102$   
 $17 \times 7 = \square$   
 $15 \times 7 = \square$   
 $15 \times 9 = \square$   
 $15 \times 18 = \square$

Different Ways

Ways to calculate  $24 \times 8$ :

$\square$  less than  $24 \times 10$

$\square$  less than  $25 \times 8$

Double  $\square \times \square$

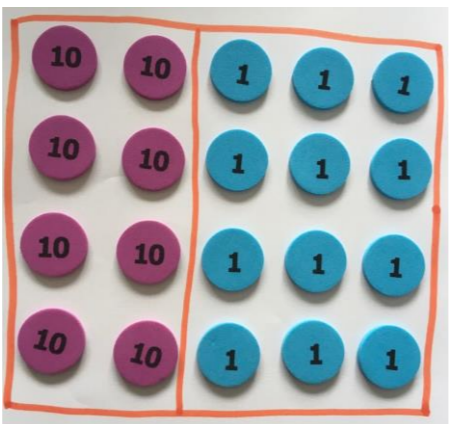
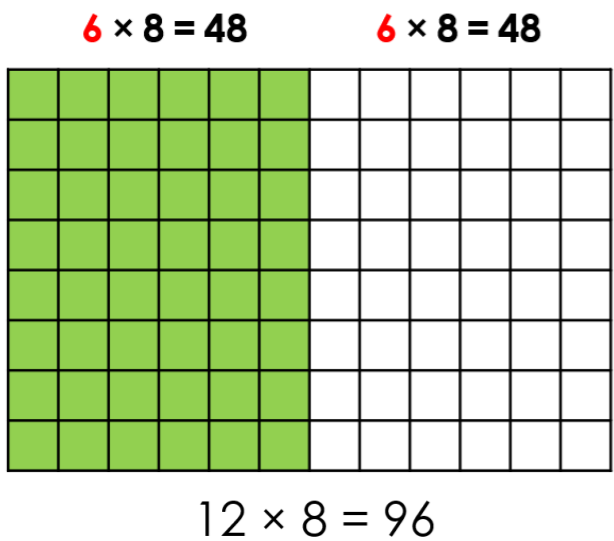
Visual, less challenge in calculation, pre-cursor knowledge

Visual → abstract, part-complete examples, small variation, misconceptions

Compare methods, make choices, compare difficulty, develop fluency

Create questions, find multiple answers, see links to other areas of maths,

Novice



Part-Complete Examples

$$\begin{array}{r} 489 \\ \times 5 \\ \hline 45 \\ \hline 44 \end{array}$$

$$\begin{array}{r} 723 \\ \times 4 \\ \hline 2 \\ \hline 1 \end{array}$$

Explain the Mistakes

$$\begin{array}{r} 261 \\ \times 4 \\ \hline 8244 \end{array}$$

$$\begin{array}{r} 417 \\ \times 5 \\ \hline 2055 \\ 3 \end{array}$$

Expert

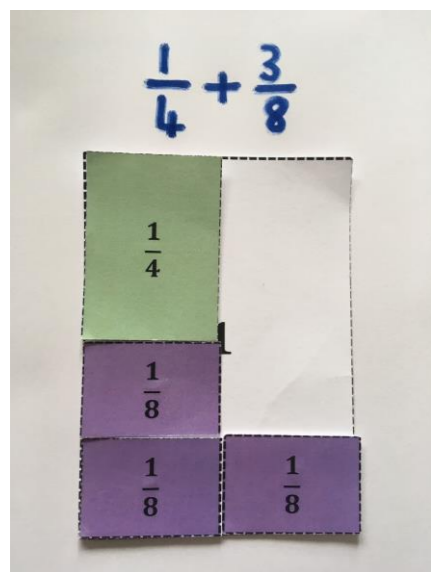
How Many Ways?

Complete using digits 0-9. The digit in the box with a border must be odd.

$\square \square \times \square = \square \square$

- Level 1: I can find a way
- Level 2: I can find different ways
- Level 3: I know how many ways there are

# Progression in Reasoning: Fractions



## Explain the Mistakes

Mistake A:

$$\frac{1}{4} + \frac{3}{8} = \frac{4}{12}$$

Mistake B:

$$\frac{1}{4} + \frac{3}{8} = \frac{4}{8}$$

## Rank by difficulty

$$\frac{3}{9} + \frac{7}{9}$$

$$\frac{3}{6} + \frac{5}{10}$$

$$\frac{1}{5} + \frac{3}{10}$$

$$\frac{4}{7} + \frac{2}{7}$$

$$\frac{1}{3} + \frac{2}{5}$$

## How many ways?

$$\frac{\square}{8} + \frac{1}{\square} = \frac{\square}{4}$$

The answer must be a proper fraction

Level 1: I can find a way

Level 2: I can find different ways

Level 3: I know how many ways there are

Visual, less challenge in calculation, pre-cursor knowledge

Visual → abstract, part-complete examples, small variation, misconceptions

Compare methods, make choices, compare difficulty, develop fluency

Create questions, find multiple answers, see links to other areas of maths,

**Novice**

## Small Steps

For each calculation, **choose a common denominator**:

$$\frac{3}{5} + \frac{3}{5} \text{ Common denominator: } \square$$

$$\frac{2}{3} + \frac{1}{6} \text{ Common denominator: } \square$$

$$\frac{5}{10} + \frac{1}{2} \text{ Common denominator: } \square$$

## Small Variation Questions

$$\frac{1}{3} + \frac{1}{6} = \square$$

$$\frac{1}{4} + \frac{1}{12} = \square$$

$$\frac{1}{3} + \frac{3}{6} = \square$$

$$\frac{3}{4} + \frac{1}{12} = \square$$

$$\frac{2}{3} + \frac{3}{6} = \square$$

$$\frac{3}{4} + \frac{5}{12} = \square$$

## Different Methods

Ways to calculate  $\frac{3}{4} + \frac{5}{8}$

Convert  $\frac{3}{4}$  into  $\frac{\square}{\square}$

$\frac{1}{2} + \frac{1}{2} + \frac{\square}{4} + \frac{\square}{8}$

Split  $\frac{5}{8}$  into  $\frac{\square}{8}$  and  $\frac{\square}{8}$

**Expert**