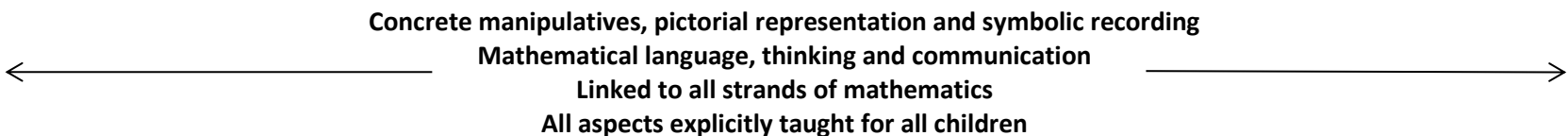


**What is fluency, reasoning and problem solving? What are the differences? What are the connections?**

<p><b>Fluency - become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils have conceptual understanding and are able to recall and apply their knowledge rapidly and accurately to problems.</b></p> <p>Conceptual fluency e.g. exploring five strands of place value, what an equivalent fraction is and identifying features of different representations of data.</p> <p>Procedural fluency e.g. <math>+</math> <math>-</math> <math>\times</math> <math>\div</math> calculation methods linked to whole numbers, fractions and decimals and exploring step by step methods.</p> <p>Recall of known facts, developing number sense, children know why they are doing what they are doing and know when it is appropriate and efficient to choose different methods and applying skill to multiple contexts e.g. <math>\times</math> by 10 to convert units of measurements.</p> <p><i>Accurate recall of facts and methods need to be kept 'bubbling' to ensure children do not forget e.g. basic skills sessions, Fluent in Five materials and number of the week.</i></p>	<p><b>Reasoning - reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language.</b></p> <p>Conjectures relationships and generalisations e.g. if I add an odd and an odd number it will always result in an even number or all quadrilaterals have 4 right angles – true or false?</p> <p>Developing an argument, justification or proof using mathematical language e.g. prove it, justify, convince me, how can you work it and how did you work it out?</p> <p>Reasoning twists – alike and different, odd one out, true or false, spot the mistake and sometimes, always or never true (NCETM reasoning progression charts).</p> <p><i>Model and encourage children to consider what sort of answer or working out is required linked to different reasoning questions e.g. verbally explaining, using words or numerals and symbols, pictorial representations such as place value charts or tables and use of concrete equipment.</i></p>	<p><b>Problem solving - 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.</b></p> <p>Secures and builds upon conceptual understanding (fluency) and mathematical thinking and language (reasoning) to help solve sophisticated problems in unfamiliar contexts.</p> <p>Explore five types of problem solving in different strands of mathematics –</p> <ol style="list-style-type: none"> <li>1. Two and three step word problems including bar model</li> <li>2. Finding all possibilities</li> <li>3. Finding rules and describing patterns</li> <li>4. Diagram problems and visual puzzles</li> <li>5. Logic problems</li> </ol>
<p align="center"><b>UNDERSTANDING, EFFICIENCY, ACCURACY AND FLEXIBILITY</b></p>	<p align="center"><b>EXPLORING AND PROVING IT! 'Glue which helps mathematics make sense'</b></p>	<p align="center"><b>APPLYING AND PERSEVERING</b></p>
<p align="center">    <b>Concrete manipulatives, pictorial representation and symbolic recording</b>  <b>Mathematical language, thinking and communication</b>  <b>Linked to all strands of mathematics</b>  <b>All aspects explicitly taught for all children</b> </p>		

**What is fluency, reasoning and problem solving? What are the differences? What are the connections?**