

Conceptual reasoning

Key thinking competency	Supporting thinking skills	Criteria for thinking competencies	Sample critical thinking questions to support the development of competencies
<p>Conceptual reasoning:</p> <p>The ability to construct an understanding of the properties that define a mathematical concept, idea or truth and to use this understanding to effectively identify and apply concepts.</p> <ol style="list-style-type: none"> helps to communicate mathematical background knowledge <i>with depth, clarity and precision</i> helps to <i>accurately</i> recognize mathematical ideas at play in problems and the world (what math is in the problem or how the world functions) 	<p>Related verbs:</p> <ul style="list-style-type: none"> - construct and deconstruct meaning - compare/contrast (to identify properties or commonalities shared across examples/cases) - seek patterns (sort) - exemplify - generalize - induce/deduce - symbolize 	<p>Criteria for <i>conceptual reasoning</i>:</p> <p><u>Inductive thinking</u>: consider</p> <ul style="list-style-type: none"> -a <i>comprehensive and relevant</i> set of examples; -what is already known and understood to be <i>mathematically true</i> about each example; -the attributes (properties) <i>consistently</i> shared by the examples, including or eliminating examples that do/do not share the properties <p><u>Deductive thinking</u>: consider</p> <ul style="list-style-type: none"> -the attributes or properties that give a mathematical idea it's <i>true/accepted</i> meaning; - how <i>consistently</i> the attributes or properties fit other examples - include or eliminate examples that do/do not <i>fully</i> share the attributes or properties 	<p>What do all of these <i>true</i> examples have in common?</p> <p>Sort these examples into groups that <i>fully and consistently</i> share in the same attribute or properties.</p> <p>Is it <i>always</i> true that...? OR How consistently is it true that...?</p> <p>Is this a <i>true</i> example of the concept or mathematical idea of...?</p> <p>Provide an example of (an idea or concept) that <i>exemplifies</i> it (fully possesses all of its <i>essential</i> attributes or properties).</p> <p>What is a <i>counter</i> (no) example of this idea or concept?</p>

Sound reasoning

Key thinking competency	Supporting thinking skills	Criteria for thinking competencies	Sample critical thinking questions to support the development of competencies
<p>Sound reasoning (metacognition)</p> <p>The ability to think about the quality of one’s reasoning to ensure that it is mathematically sound or reasonable.</p> <ol style="list-style-type: none"> 1. supports effective sense making 2. ensures on-going self-reflection, self-regulation, and self-correction 3. nurtures scepticism (questioning of proposed ideas and solutions) for quality control and creation or innovation 4. promotes efficient and productive mistake-making 5. nurtures fluency and automaticity 	<p>Related verbs:</p> <ul style="list-style-type: none"> - conjecture (estimate) - make sense - reflect - organize - plan - design - select - apply - generate - relate - generalize - justify - conclude - argue - refute - defend - assess/evaluate - deduce/induce - prove - model - present - manipulate - work backwards 	<p>Criteria for sound reasoning:</p> <p>Mathematical decision-making (conclusion-drawing or solving) that is...</p> <ul style="list-style-type: none"> - consistent with the identification or generation, and assessment of plausible options using relevant criteria - consistent with access and use of appropriate, relevant, mathematically truths (existing or constructed background knowledge and/or information) using relevant criteria 	<p>What is the most likely outcome (solution, conclusion, decision) to this problem?</p> <p>Does your thinking about this relationship, this solution, this representation... make sense?</p> <p>Structure/organize this solution, argument or proof in a logical way.</p> <p>Effectively justify the answer, solution, conclusion, decision, or argument.</p> <p>Which form of reasoning (thinking) is appropriate (required) to solve this problem or complete this task (inductive or deductive=constructing or deconstructing, working from the details forward or the idea backwards—or any other thinking verb)?</p> <p>How reasonable/sound is this... argument, conclusion, decision, solution?</p> <p>Is the thinking in this...flawed? Or How flawed is the thinking represented in...?</p>