

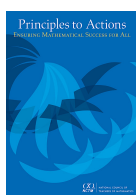
## Teacher and Student Actions for Effective Mathematics Teaching and Learning

**Pose purposeful questions.** Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.

What are teachers doing?	What are students doing?
<ul style="list-style-type: none"> <li><input type="checkbox"/> Advancing student understanding by asking questions that build on, but do not take over or funnel, student thinking.</li> <li><input type="checkbox"/> Making certain to ask questions that go beyond gathering information to probing thinking and requiring explanation and justification.</li> <li><input type="checkbox"/> Asking intentional questions that make the mathematics more visible and accessible for student examination and discussion.</li> <li><input type="checkbox"/> Allowing sufficient wait time so that more students can formulate and offer responses.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Expecting to be asked to explain, clarify, and elaborate on their thinking.</li> <li><input type="checkbox"/> Thinking carefully about how to present their responses to questions clearly, without rushing to respond quickly.</li> <li><input type="checkbox"/> Reflecting on and justifying their reasoning, not simply providing answers.</li> <li><input type="checkbox"/> Listening to, commenting on, and questioning the contributions of their classmates.</li> </ul>

**Use and connect mathematical representations.** Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.

What are teachers doing?	What are students doing?
<ul style="list-style-type: none"> <li><input type="checkbox"/> Selecting tasks that allow students to decide which representations to use in making sense of the problems.</li> <li><input type="checkbox"/> Allocating substantial instructional time for students to use, discuss, and make connections among representations.</li> <li><input type="checkbox"/> Introducing forms of representations useful to students.</li> <li><input type="checkbox"/> Asking students to make math drawings or use other visual supports to explain and justify their reasoning.</li> <li><input type="checkbox"/> Focusing students' attention on the structure or essential features of math ideas that appear, regardless of the representation.</li> <li><input type="checkbox"/> Designing ways to elicit and assess students' abilities to use representations meaningfully to solve problems.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Using multiple forms of representations to make sense of and understand mathematics.</li> <li><input type="checkbox"/> Describing and justifying their mathematical understanding and reasoning with drawings, diagrams, and other representations.</li> <li><input type="checkbox"/> Making choices about which forms of representations to use as tools for solving problems.</li> <li><input type="checkbox"/> Sketching diagrams to make sense of problem situations.</li> <li><input type="checkbox"/> Contextualizing mathematical ideas by connecting them to real-world situations.</li> <li><input type="checkbox"/> Considering the advantages or suitability of using various representations when solving problems.</li> </ul>



National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*. Reston, VA: Author.

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