

**2014 Mathematics Institutes**

The purpose of the 2014 Mathematics Institutes is to provide teachers with professional development focused on the instruction that supports process goals for students in mathematics. The emphasis of this professional development will be on fostering students' abilities to make mathematical connections and use effective and appropriate representations in mathematics.

**Professional Development Instructions**

A product of the 2014 Mathematics Institutes is a set of online professional development modules designed to be used by a group of teachers of a specific grade level or course, facilitated by a member of the team. Modifications could be made to adapt the professional development for more than one grade level/course or for large groups. Facilitators should review the activities and handouts in this guide prior to facilitating this professional development.

**[Virginia's Process Goals for Students](#)**

**SOL Vertical Articulation Technical Assistance Documents**

- [Grades K-3](#)
- [Grades 3-6](#)
- [Grades 5-8](#)
- [Algebra](#)
- [Geometry](#)

Approximate Time	Facilitator Instructions	Materials
45 minutes total	<p><b>Module 1: Participant personal reflection on representations and connections</b>  <b>Essential Question: What does it mean for students to represent and make connections in the mathematics classroom?</b></p> <p>1) Think (individually)/Pair (share with a partner)/Share (with the whole group):</p> <ul style="list-style-type: none"> <li>– Pair: When you hear the term representations, what does it mean to you? Take turns sharing thoughts.</li> <li>– Whole group: What does it mean for students to use effective and appropriate representations in the mathematics classroom?</li> <li>– Table: Why is it important for students to make connections in mathematics? Share an example of a connection students should make?</li> <li>– Whole group: What does it mean for students to make connections in the mathematics classroom?</li> </ul> <p>2) Whole group discussion: Compare and contrast the groups' discussion points with Process Goals for Students: Representations and Connections document.</p> <p>3) Whole group discussion: What questions should be considered regarding representations and connections when planning for instruction? This list should be recorded for use in Module 5.</p>	<ul style="list-style-type: none"> <li>• <a href="#">Process Goals for Students: Representations and Connections</a></li> </ul>

Approximate Time	Facilitator Instructions	Materials
50 minutes total	<p><b>Module 2: Mathematical task</b></p> <ol style="list-style-type: none"> <li>1) List the characteristics of the figures that change as the pattern progresses.</li> <li>2) Table discussion: Share the list of attributes you brainstormed. Ensure that the language used to define each attribute is concise and precise.</li> <li>3) Whole group: Create a “master list” of attributes.</li> <li>4) Table: Select one attribute that your group would like to explore further. Describe the step-by-step changes of that attribute in as many different ways as possible. Use chart paper and markers to record and summarize your ideas.               <ul style="list-style-type: none"> <li>– Which mathematical ideas are engaged during work on this task?</li> <li>– Which representation did your group use initially? Why? Was it effective?</li> </ul> </li> <li>5) Share your groups work with the whole group.               <ul style="list-style-type: none"> <li>– Are there similarities and differences in the growth of different attributes?</li> <li>– Do particular types of attributes result in particular types of growth?</li> </ul> </li> <li>6) Whole group discussion: Identify the mathematical content addressed in the task.</li> </ol>	<ul style="list-style-type: none"> <li>• <a href="#">Mathematical task</a></li> </ul>
45 minutes total	<p><b>Module 3: Looking at student work</b></p> <p><b>Essential Question: How are students using representations and making connections in their work?</b></p> <ol style="list-style-type: none"> <li>1) As we prepare to look at high school student work samples for this task, think about the following:               <ul style="list-style-type: none"> <li>– What representations do you predict students will use?</li> <li>– In what ways might the students connect the representations they use?</li> </ul> </li> <li>2) Partner or small group discussion: View the student work samples. Use the Student Work Recording Sheet to note your observations:               <ul style="list-style-type: none"> <li>– What representations are evident in each student’s work? What are the similarities and differences?</li> <li>– What does the student work tell us about their understanding? How do the representations give clues to student understanding?</li> </ul> </li> <li>3) Partner or small group discussion:               <ul style="list-style-type: none"> <li>– What evidence is there that students are making connections within their own work?</li> <li>– How could the student work be used to help all students make connections                   <ul style="list-style-type: none"> <li>○ among representations,</li> </ul> </li> </ul> </li> </ol>	<ul style="list-style-type: none"> <li>• <a href="#">Student work</a></li> <li>• <a href="#">Student Work Recording Sheet</a></li> </ul>

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	<ul style="list-style-type: none"> <li>○ among strategies, or</li> <li>○ among mathematical ideas?</li> </ul> <p>4) Whole group discussion: How do the various student representations communicate</p> <ul style="list-style-type: none"> <li>– student understanding of the mathematics,</li> <li>– student generalizations of the mathematics, and</li> <li>– mathematical relationships?</li> </ul>	
<b>40 minutes total</b>	<p><b>Module 4 Part 1: Planning for the use of representations and connections in instruction</b></p> <p><b>Essential Question: What should be considered regarding representations and connections when planning for instruction?</b></p>	<ul style="list-style-type: none"> <li>• <a href="#">Equation and Functions Learning Progression</a></li> <li>• <a href="#">Mathematics Instructional Connections for Physical and Visual Representations</a></li> </ul>
	<p>1) Partner or small group discussion: Consider the list of questions brainstormed in Module 1:</p> <ul style="list-style-type: none"> <li>– What questions should be added? Which questions should be revised?</li> <li>– What are the difficulties of implementing high-level tasks in the classroom?</li> </ul> <p>2) Whole group: View the Conjecturing about Functions video, making notes on teacher moves and student moves on the Video Reflection Recording Chart document.</p> <ul style="list-style-type: none"> <li>– What representations are the students using? How are they connecting their representations?</li> <li>– What did the teacher do to facilitate the students' discourse?</li> <li>– What did the teacher do to develop students' use of representations and connections?</li> <li>– What are the roles of the teacher and the student?</li> </ul>	<ul style="list-style-type: none"> <li>• <a href="#">Conjecturing about Functions video</a>, <i>The Teaching Channel</i>.</li> <li>• <a href="#">Video Reflections Recording Chart</a></li> </ul>
<b>40 minutes total</b>	<p><b>Module 4 Part 2: Planning for the use of representations and connections in instruction</b></p> <p><b>Essential Question: What should be considered regarding representations and connections when planning for instruction?</b></p>	<ul style="list-style-type: none"> <li>• <a href="#">Sorting Functions Task</a>, <i>Insidemathematics.org</i></li> </ul>
	<p>1) Partner or small group activity: Read the Sorting Functions Task and complete the activity.</p> <ul style="list-style-type: none"> <li>– Which mathematical ideas are engaged during work on this task? What important algebraic ideas might students use to match a graph with an equation?</li> <li>– Which representation did the group use initially? Why? Was it effective?</li> <li>– What connections do you hope students are making to relate this information?</li> </ul> <p>2) Small group or whole group discussion: Analysis of the rubric.</p>	

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	<ul style="list-style-type: none"> <li>– What would be considered correct in terms of the mathematical content?</li> <li>– What would be considered a correct explanation?</li> </ul>	
<b>45 minutes total</b>	<p><b>Module 4 Part 3: Planning for the use of representations and connections in instruction</b></p> <p><b>Essential Question: What should be considered regarding representations and connections when planning for instruction?</b></p>	<ul style="list-style-type: none"> <li>• <a href="#">Sorting Functions Task, Insidemathematics.org</a></li> <li>• <a href="#">Equation and Functions Learning Progression</a></li> <li>• <a href="#">Mathematics Instructional Connections for Physical and Visual Representations</a></li> </ul>
	<p>1) Small group or whole group discussion: Consider the mathematical task completed in Module 4 Part 2.</p> <ul style="list-style-type: none"> <li>– What is the mathematics of this task? Based on teacher observations, what should algebra students know and be able to do? What are the areas of difficulty for algebra students?</li> <li>– What does the student data analysis reveal?</li> <li>– Refer to the Equation and Functions Learning Progression document               <ul style="list-style-type: none"> <li>○ What is the related content (prior knowledge) from previous and future grade(s)/course(s)?</li> <li>○ How is the objective connected to the related content and to the real world?</li> </ul> </li> <li>– Refer to the Mathematics Instructional Connections for Physical and Visual Representations document               <ul style="list-style-type: none"> <li>○ What representations/strategies may have been used to develop prior knowledge?</li> <li>○ What representations could be used to develop and reinforce understanding of the content?</li> <li>○ Which representations/strategies will model the mathematics and deepen and extend students' mathematical understanding?</li> <li>○ What are the strengths and limitations of the representation/strategy?</li> </ul> </li> </ul>	
<b>45 minutes total</b>	<b>Module 5: Closure</b>	<ul style="list-style-type: none"> <li>• Skip Fennell's NCTM <a href="#">President's Message</a></li> <li>• <a href="#">Planning Mathematics Instruction: Essential Questions</a></li> </ul>
20 minutes	<p>1) Small group discussion: Review and revise the list of questions brainstormed in Module 1: "What questions should be considered regarding representations and connections when planning for instruction?"</p> <p>2) Whole group discussion: In what ways did your small group discussion support the following quote?</p>	

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	“Representation should be an important element of lesson planning. Teachers must ask themselves, ‘What models or materials (representations) will help convey the mathematical focus of today’s lesson?’” – Skip Fennell	
25 minutes	3) Small group discussion: Compare the list of questions to be considered regarding representations and connections when planning for instruction with the Planning Mathematics Instruction: Essential Questions document.	