Algebra Readiness

*for* Every Student

NCTM Interactive Institute for Grades 6-8

July 20-22, 2015

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NCTM Board of Directors
Post Cards with a View!

• As you enter look through the postcards and find one that indicates how you view yourself as a mathematics teacher leader.

AND THEN

• Select another that describes something fun about yourself as an individual!
• Have fun getting to know one another!
• We will start at 9 a.m.
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Schedule Overview

• Welcome & Goals
• Focused ½ day on professional development
• Daily Reflection Sessions
  – Monday: Immediately following the Institute
    • 4:30-5:30 p.m.
  – Tuesday: Immediately following the Institute
    • 4:30-5:15 p.m.
Who we are!

• **Briefly** introduce yourselves at your tables.
  – Name, role, Purpose in being here

• Share both postcards with group at your table.

• As a group—be prepared to share one observation (interesting thing) with the whole group
Algebra Institute’s Goals

1. gain strategies to build the *foundation of knowledge and skills* that lead to students' future success in algebra;

2. use *Principles to Actions* as a tool for learning new *instructional techniques* for posing purposeful questions, engaging students in productive discourse, and building student responsibility within the community of learners;

3. learn strategies for implementing *tasks that promote reasoning and problem solving* and provide all students with opportunities to develop strong algebraic reasoning skills, including the development of conjectures and generalizations;

4. determine the role of the *Standards for Mathematical Practice* in instructional strategies and assessments; and

5. understand how concepts within multiple domains of the Common Core State Standards *support algebraic reasoning*. 
• Examine models of professional development that support teachers as learners, teachers as teachers, and teachers as reflective practitioners
• Develop lens for Institute participation for professional development focus
• Make plans for developing professional development to address the Algebra Institute’s focus
• Engage in non-routine mathematical problem(s)
• Examine student work and role in PD
• Discuss evidence of mathematical practices
• Identify student and teacher misconceptions
• Analyze various professional development models for implementation
• Consider lens for participating in the institute to support development of PD
• Develop PD plan
## Content Progression

<table>
<thead>
<tr>
<th>Grade</th>
<th>Focus Areas</th>
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</thead>
</table>
| 6th   | Writing expressions with a focus on variable
|       | Solving equations using multiple techniques
|       | Graphing relationships: focus on multiple representations |
| 7th   | Writing expressions with a focus on variable behavior and quantitative relationships |
|       | Solving equations using multiple techniques |
|       | Graphing relationships: focus on multiple representations, proportional and non-proportional contexts |
| 8th   | Writing expressions and equations |
|       | Solving systems of equations using multiple strategies |
|       | Graphing relationships with a focus on slope and transformations |
Questions to Consider

• How do you lead teachers to engage in Algebraic Readiness?
• What type of professional development will work best in your situation?
• What type of leadership model will be beneficial to implement?
Brainstorming!

• Small Group Discussion
  – What types of professional development models do you currently use and/or have some knowledge of?
  – List on paper at table

• Share with whole group
Types of PD Models

- Lesson Study
- Action Research
- Analysis of Student Work
- Coaching
- PLCs
- Grade Level Teams
- Co-Teaching
- Train-the-Trainer

- Workshop Model
- Partnership (ex. HE)
- Mathematics Teacher Circle
- Book Study
- On-line Options
- Problem Solving
- Case Study Analysis
  – “Studio” Time
Identifying Considerations

• What are specific considerations that you believe you have to address or think about as you begin to consider professional development planning (i.e. duration and timing)

• Discuss in small groups then share whole group
Identify their Considerations

- Type & Duration (Long term & On-going)
- Timing (After school, summer, during school day)
- Supporting tools
- Grade level configurations
- Participants (resource teachers, others)
- Resources needed
- Administrative Support needed
- Assessing need and impact
- Effective Facilitation
CCSS-M Mathematical Practices
Represent what students are doing as they learn mathematics

• Make sense of problems and persevere in solving them.
• Reason abstractly and quantitatively.
• Construct viable arguments and critique the reasoning of others.
• Model with mathematics.
• Use appropriate tools strategically.
• Attend to precision.
• Look for and make use of structure.
• Look for and express regularity in repeated reasoning.
Mathematics Teaching Practices
(NCTM, PtA 2014, p. 10)

1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency from conceptual understanding.
7. Support productive struggle in learning mathematics.
8. Elicit and use evidence of student thinking.
Candy Jar Problem

1. 5 minutes to work individually
2. 8 minutes to share at table (various approaches)
3. 8 minutes to record different strategies to post on wall

Suppose you have a new candy jar with the same ratio of Jolly Ranchers (JR) to jawbreakers (JB) as shown in the picture, but it contains 100 Jolly Ranchers.

How many jawbreakers do you have?

Justify your answer.

Note: In the picture, Jolly Ranchers are represented by 5 rectangles, and jawbreakers are shown by 13 circles.

Fig. 12. The Candy Jar task. Adapted from Smith et al. (2005).
## Candy Jar Problem-Sample Student Answers

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<td>2600</td>
<td>108</td>
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<td>360</td>
<td>65</td>
<td>325</td>
<td>36</td>
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<tr>
<td>40</td>
<td>100</td>
<td>35</td>
<td>7 R 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>38.14</td>
<td>61</td>
<td>50/50</td>
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<tr>
<td>340</td>
<td>82.3</td>
<td>6.9</td>
<td>Less than 78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>30</td>
<td>38</td>
<td>but more than</td>
<td></td>
<td></td>
</tr>
<tr>
<td>240</td>
<td>87</td>
<td>160</td>
<td>65</td>
<td></td>
<td></td>
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<td>270</td>
<td>250</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not know</td>
<td>I do not</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>understand</td>
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Examining Mathematical Teaching Practices (MTP)

• Small group activity

• *A Lens for Viewing the Algebra Readiness Institute Activities*

• Considerations for Professional Development

• Each table is assigned 2 of 4 targeted MTPs to analyze around two areas
  
  – Identify the key elements or considerations of your assigned MTP
  
  – Analysis of the Mathematical Task
Mathematics Teaching Practices
(NCTM, PtA 2014, p. 10)

• #1 Establish mathematics goals to focus learning.
• #3 Use and connect mathematical representations.
• #6 Build procedural fluency from conceptual understanding.
• #8 Elicit and use evidence of student thinking.
• In what way is this MTP important to you when considering the focus of professional development for your teachers around the Algebra Institute ideas?
  – Take post it notes, one copy of PtA per group, way to record group’s ideas
  – 3 minutes at each MTP
  – Brief whole group sharing follows
NCTM New PD Resources-MTPs

- http://www.nctm.org/PtAToolkit/
Planning PD-Planning Sheet

- Algebra Readiness Goal(s)-Content & Process
- Type(s) of PD
- Audience/Participants
- Timeline/Time Allotment
- Support Needed
- Resources & Funding needed
- Assessment & Evaluation Process
- Potential Obstacles, Barriers, or challenges
- Ways to Address (above)
- Targeted Principle(s) (from PtA)
- Targeted MTP (from PtA)
- BACK PAGE: Next steps & other thoughts
PD Strand Goals - Revisited

• Examine models of professional development that support teachers as learners, teachers as teachers, and teachers as reflective practitioners

• Develop lens for Institute participation for professional development focus

• Make plans for developing professional development to address the Algebra Institute’s focus
The National Council of Teachers of Mathematics is a public voice of mathematics education, providing vision, leadership, and professional development to support teachers in ensuring equitable mathematics learning of the highest quality for all students. NCTM’s Institutes, an official professional development offering of the National Council of Teachers of Mathematics, supports the improvement of pre-K-6 mathematics education by serving as a resource for teachers so as to provide more and better mathematics for all students. It is a forum for the exchange of mathematics ideas, activities, and pedagogical strategies, and for sharing and interpreting research. The Institutes presented by the Council present a variety of viewpoints. The views expressed or implied in the Institutes, unless otherwise noted, should not be interpreted as official positions of the Council.
Thank you! Enjoy the institute!

Keep your PD plan in mind.

– See you at 4:30 today and tomorrow as well!

Access the electronic resources

– Bibliography of resources for different types of PD
– TCM & MTMS articles
– PowerPoint and handouts

Feel free to ask questions anytime!

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www.nctm.org
Facilitate Meaningful Mathematical Discourse

Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.
5 Practices for Facilitating Mathematical Discourse (Smith & Stein 2011)

1. **Anticipating** student responses prior to the lesson
2. **Monitoring** students’ work on and engagement with the tasks
3. **Selecting** particular students to present their mathematical work
4. **Sequencing** students’ responses in a specific order for discussion
5. **Connecting** different students’ responses and connecting the responses to key mathematical ideas
Student Work Analysis

- Using the student work sample(s) provided determine what order you would sequence them for *Meaningful Mathematical Discourse* (MTP #4 pages 29-35 in *PtA 2014*) in the classroom and why.
  - 14 Different Student Work Samples
  - May not necessarily use all

- If time permits, discuss how you would guide students during their work time—particularly those that seemed to struggle—incorrect answers