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Transforming Mathematics Education

Flexible & Engaging
Seamless Common Core Companion

Lead like an MVP
Leadership Conference Agenda

Day 1

- Making instructional decisions as a result of a deeper understanding of the CMI Framework.
- Using the CMI Framework to inform the work of professional learning communities in designing assessments and responding to student needs.

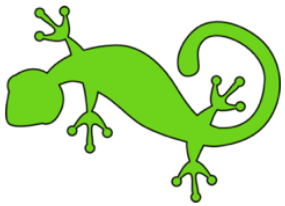
Day 2

- Understanding the continuum of teacher beliefs and practices to better support MVP implementation.
- Planning Professional Development to increase teacher mathematical knowledge for teaching.

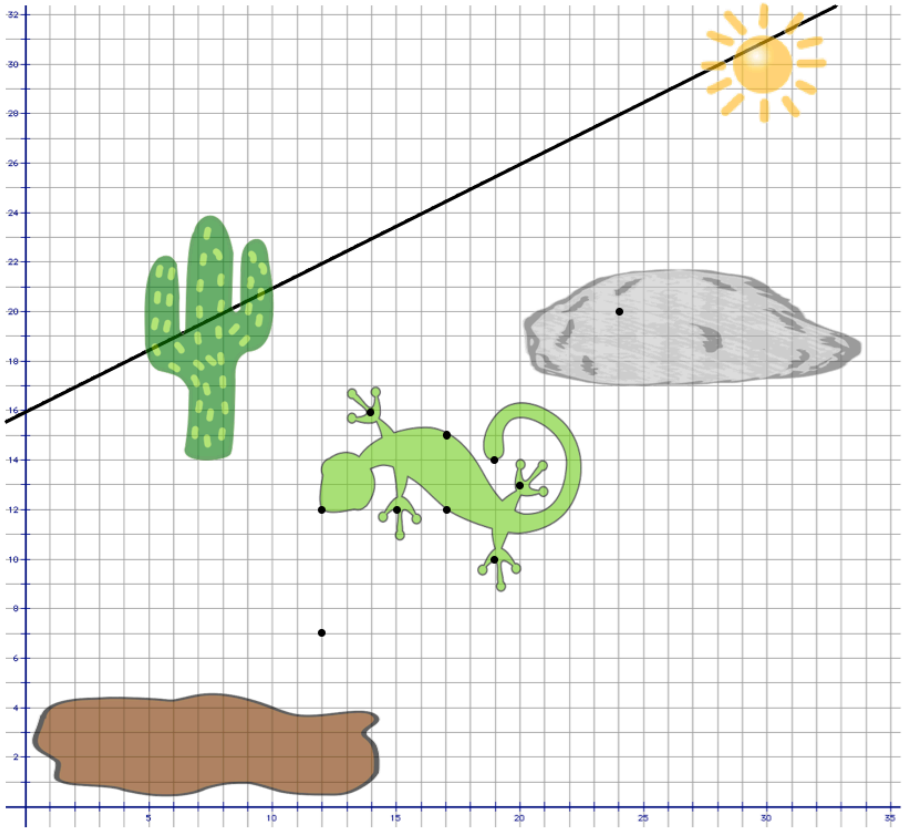
Day 3

- Sharing successful practices among districts

Engaging in mathematical thinking

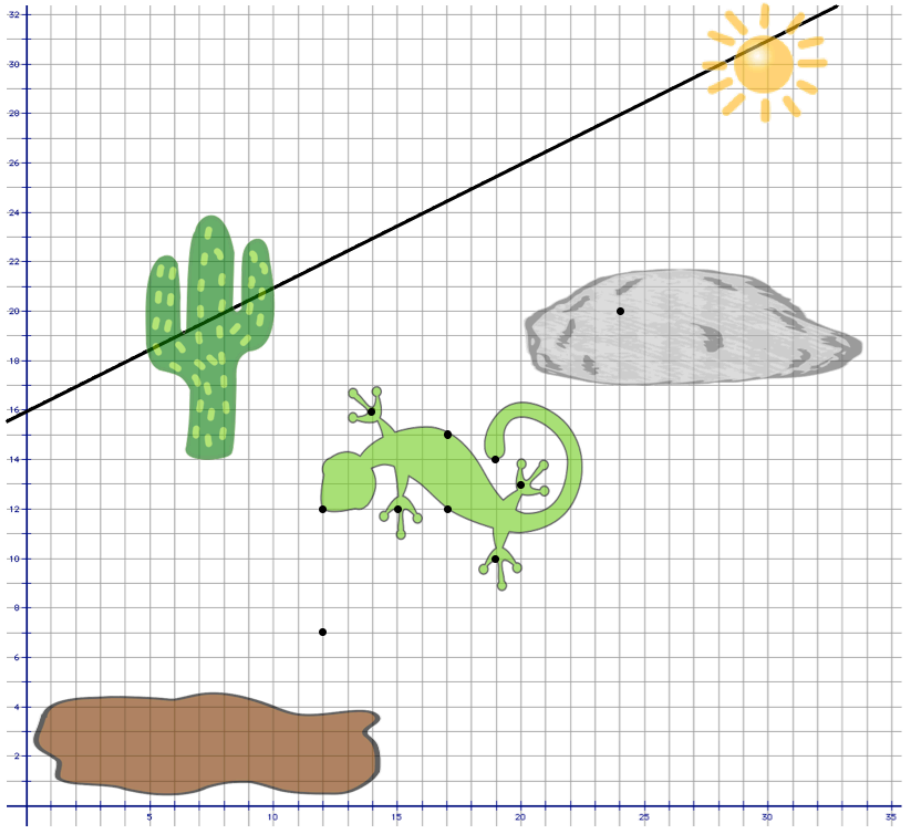


- Leaping Lizards
- Is It Right?
- Leap Frog
- Leap Year



Leaping Lizards

A Develop Understanding Task



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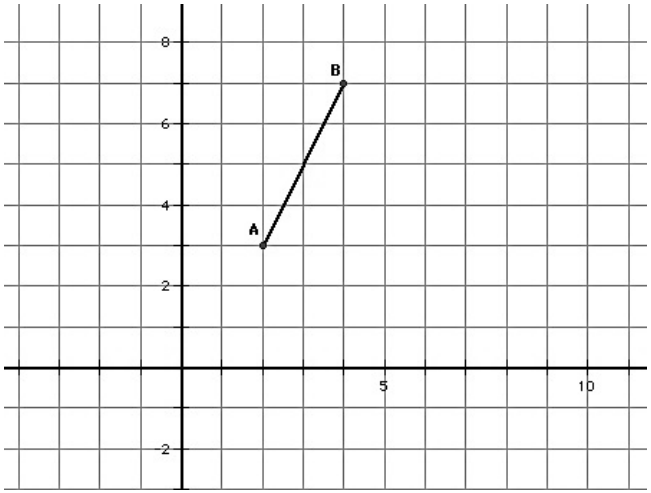
SMP Use tools strategically
Tools for geometric thinking

- What tools did you use In your work on *Leaping Lizards*?
- In your work (or the students work) on *Leaping Lizards*, what purposes did the following *tools* serve?
  - *Circles*
  - *Parallel Lines*
  - *The Coordinate Grid*

Is It Right?
A Solidify Understanding Task



- <u>Experiment 1</u>

- Consider the points A (2, 3) and B (4, 7) and the line segment between them. What is the slope of this line segment?

- Locate a third point C (x, y) on the coordinate grid, so the points A (2, 3), B (4, 7) and C (x, y) form the vertices of a right triangle, with AB as its hypotenuse.

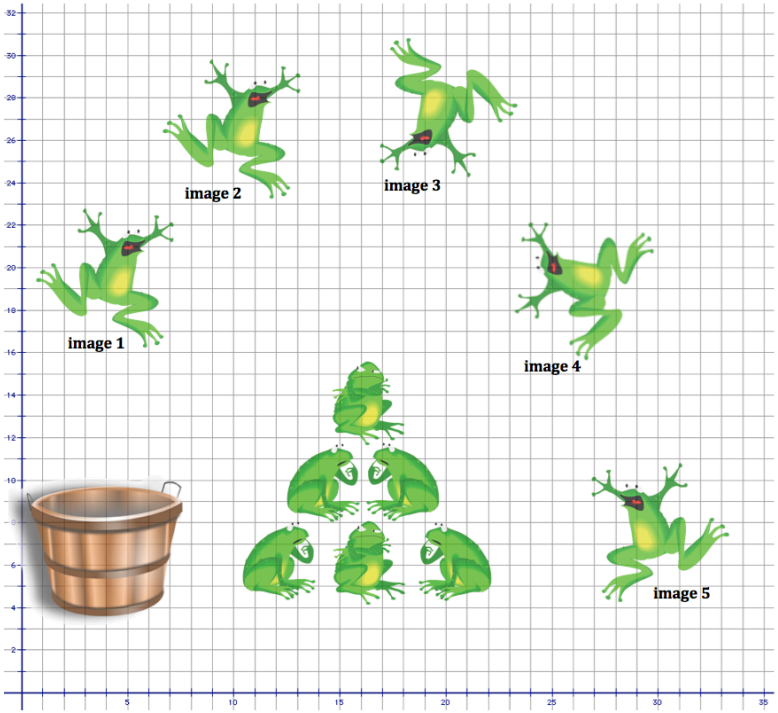
- Explain how you know that the triangle you formed contains a right angle?

- Now rotate this right triangle 90° about the vertex point (2, 3). Explain how you know that you have rotated the triangle 90°.

- Compare the slope of the hypotenuse of this rotated right triangle with the slope of the hypotenuse of the pre-image. What do you notice?

Leap Frog
A Solidify Understanding Task

- For each pre-image/image combination listed below, describe the transformation that moves the pre-image to the final image.
  - Image 3 to image 4
  - Image 1 to image 5



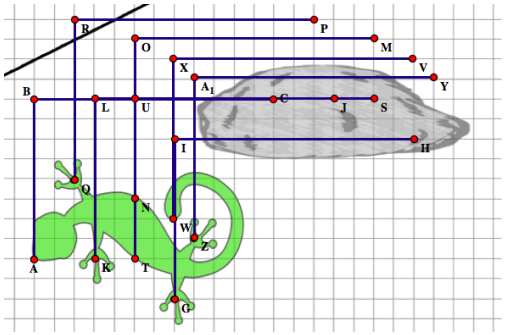
Leap Year
A Practice Understanding Task

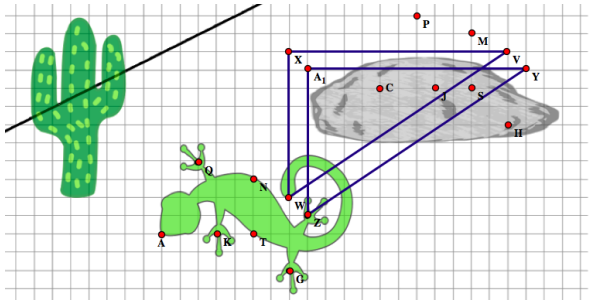
How would you complete each of the following definitions?

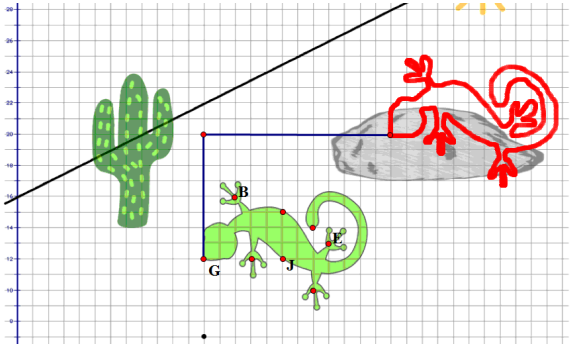
- 1. A translation of a set of points in a plane . . .
- 2. A rotation of a set of points in a plane . . .
- 3. A reflection of a set of points in a plane . . .

Definitions of rigid motion transformations as a foundation for proof

- **Are our descriptions or definitions of these transformation sufficient for the work we need to do?**







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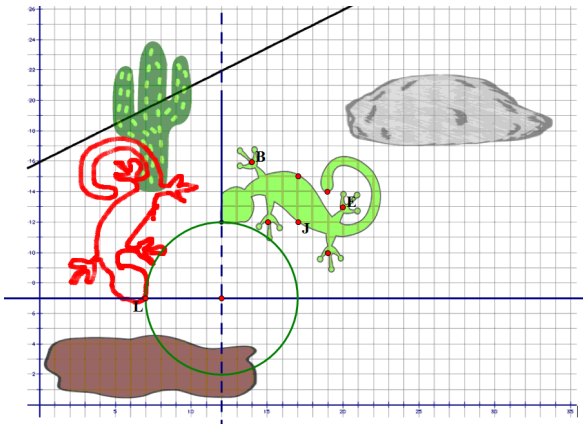

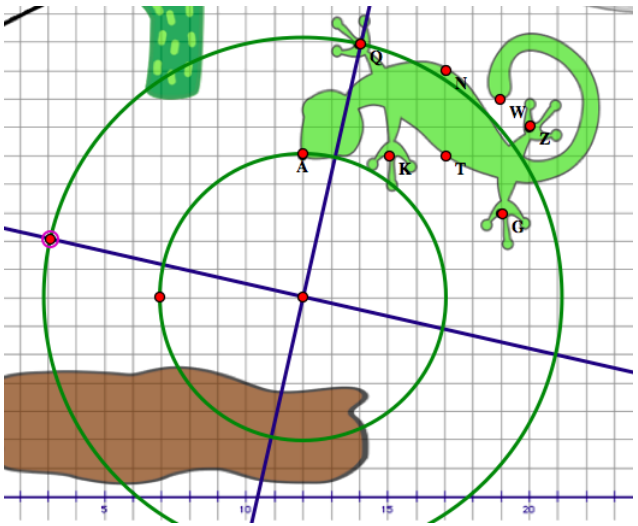

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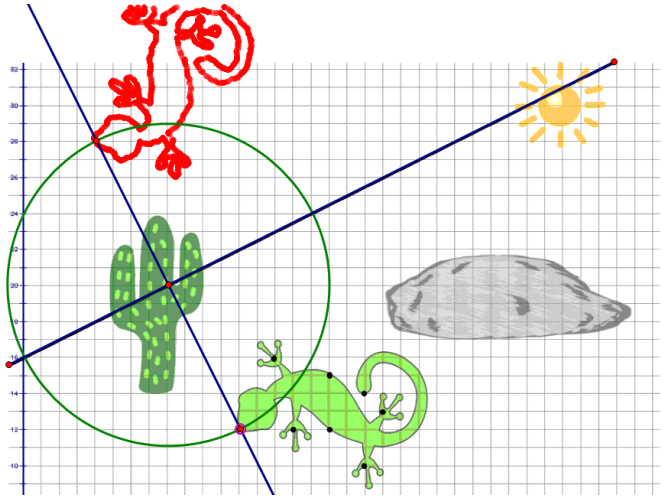
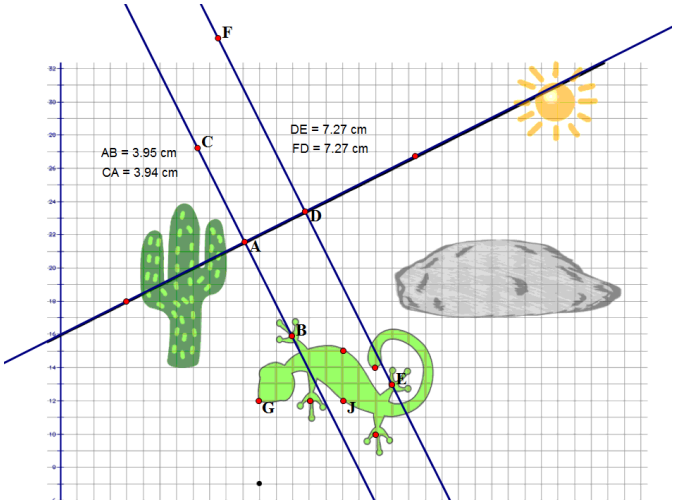




Leap Year
A Practice Understanding Task

Carlos and Clarita used these words and phrases in their definitions:

perpendicular bisector, center of rotation, equidistant, angle of rotation, concentric circles, parallel, image, pre-image, preserves distance and angle measures.

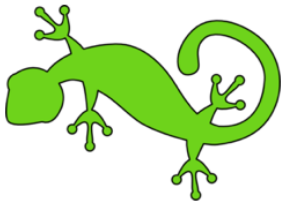
- Revise your definitions so that they also use these words or phrases.

Revisiting The Learning Cycle

Leap Year

Practice

Develop



Leaping Lizards

Solidify

Leap Frog

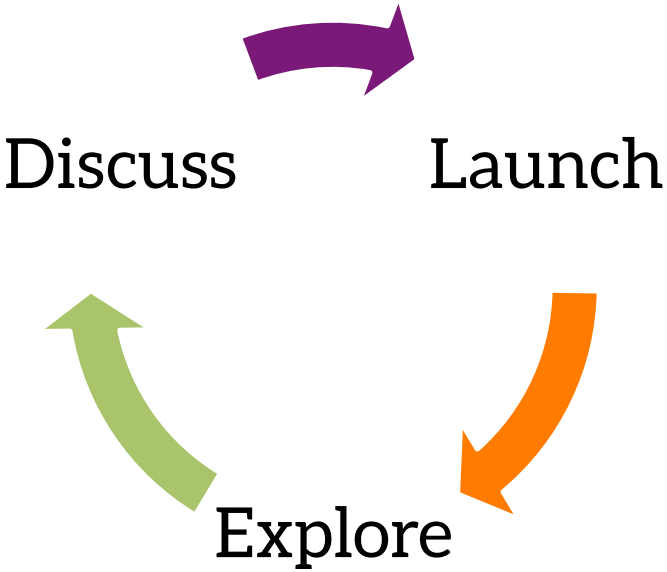
Is It Right?

Development of Definitions along the continuum.

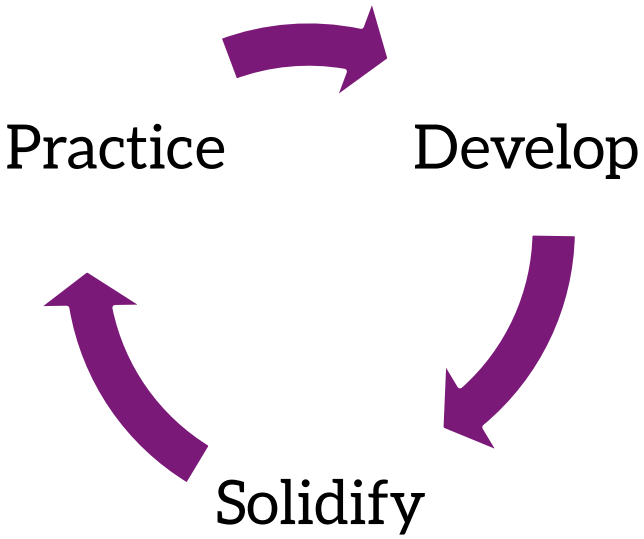
"…definitions are seldom starting points, despite their being placed at the start of discussions in many mathematics textbooks. A workable geometric definition is often the endpoint of back-and-forth negotiations between verbal formulations and a collection of drawn or imagined examples and counterexamples."

(Essential Understanding, p.43)

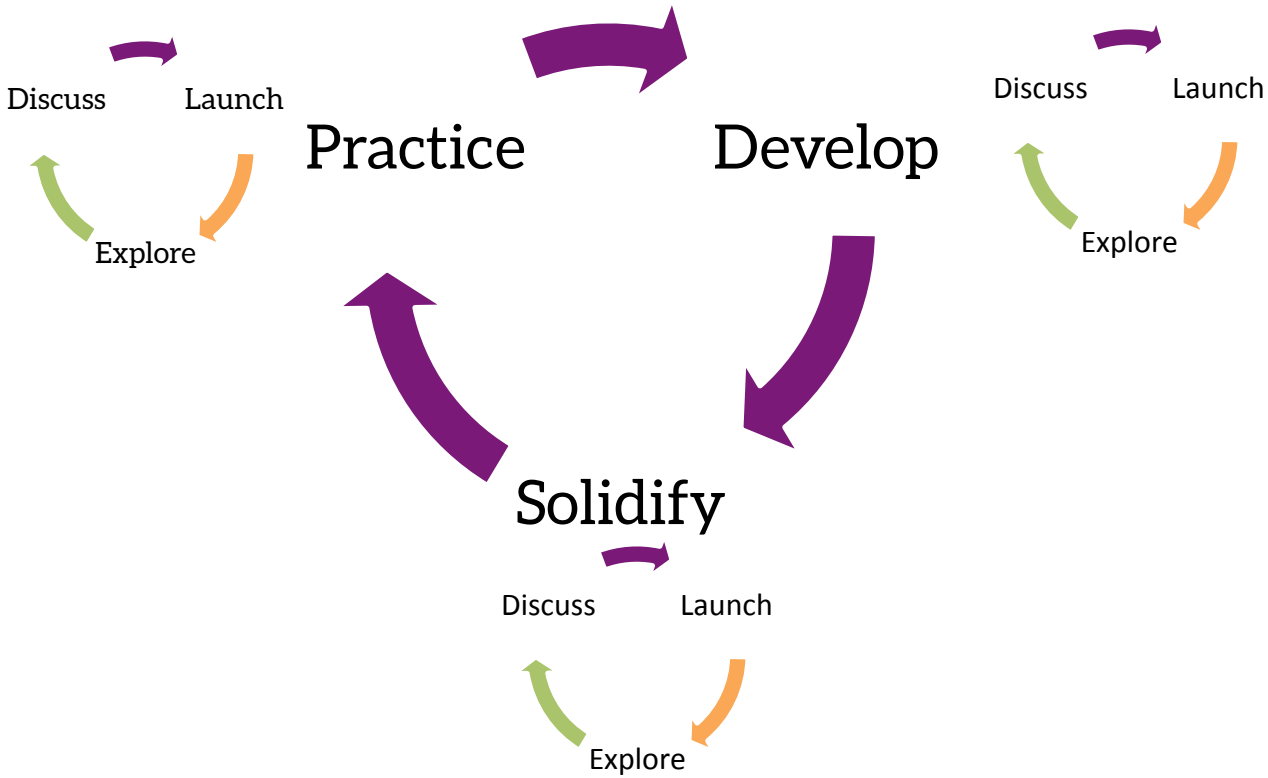
The *Teaching Cycle*



The Learning Cycle



Comprehensive Mathematics Instruction

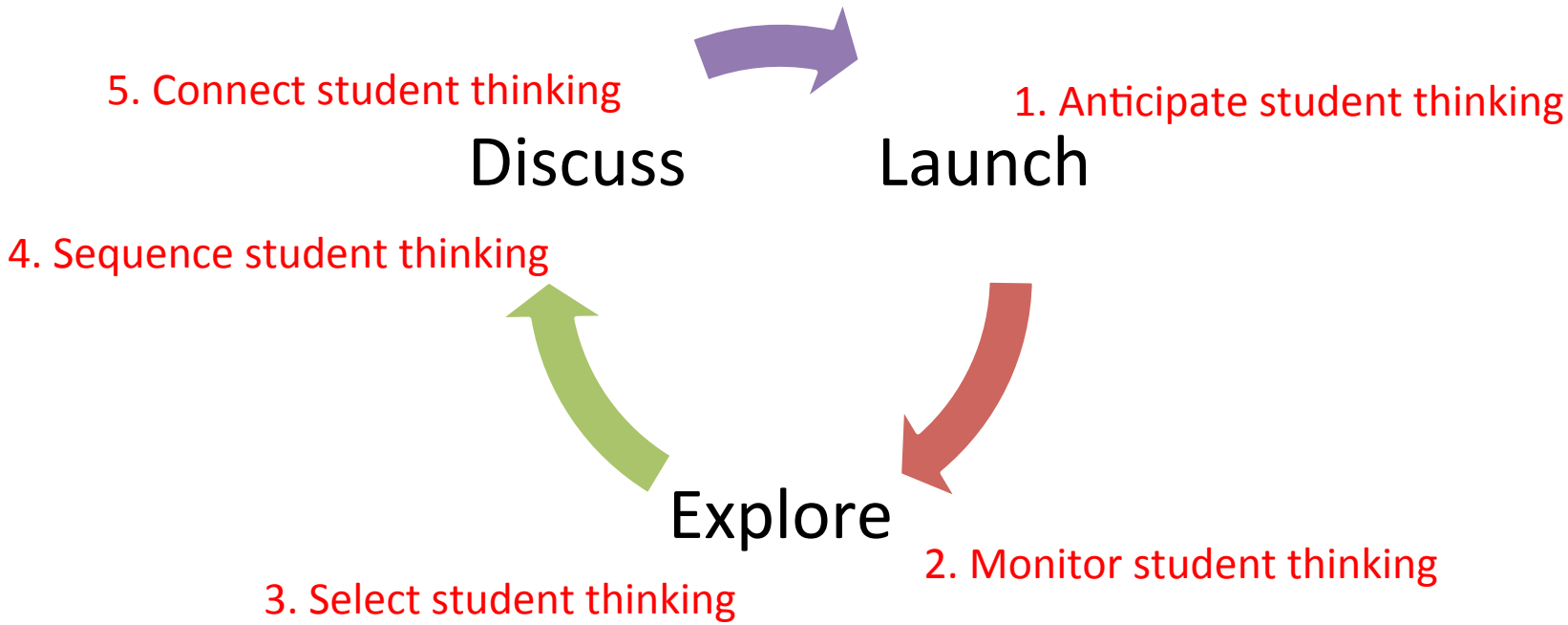


What do we want stakeholders to know about the *Teaching Cycle* and the *Learning Cycle*?

- Colleagues
- Parents
- Students
- Building Administrators
- Legislators

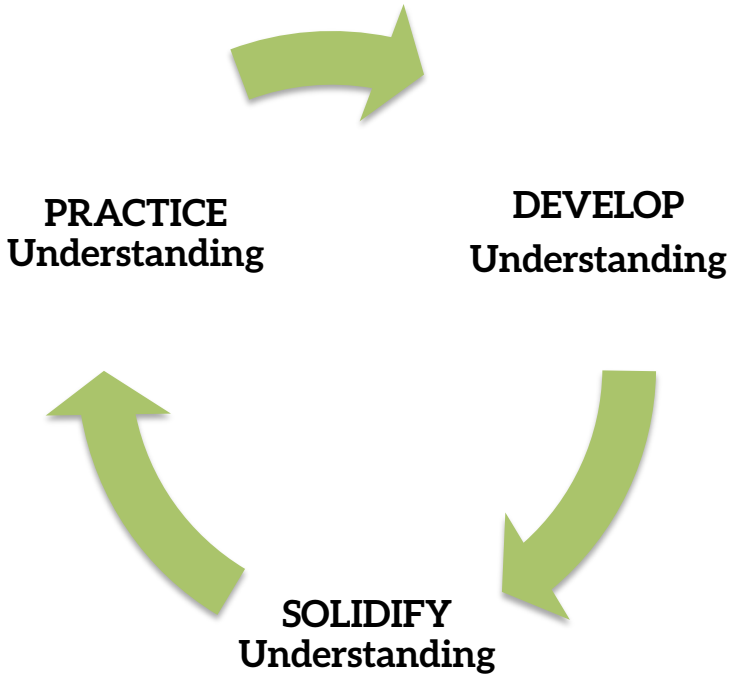
The *Teaching Cycle*

Connected to the 5 practices of Orchestrating Discussions



Task Sequencing

Comprehensive Mathematics Instruction Framework



- *Develop Understanding* tasks surface student thinking
- *Solidify Understanding* tasks examine and extend
- *Practice Understanding* tasks build fluency

The Standards for Mathematical Practice describe how people engage in mathematical thinking.

- 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.

The Continuum of Mathematical Understanding describes what people produce as they engage in mathematical thinking.

- Definitions
- Strategies
- Models
- Algorithms
- Properties
- Procedures
- Ideas
- Representations
- Tools
- Concepts

Reconstructing the Continuum of Mathematical Understanding

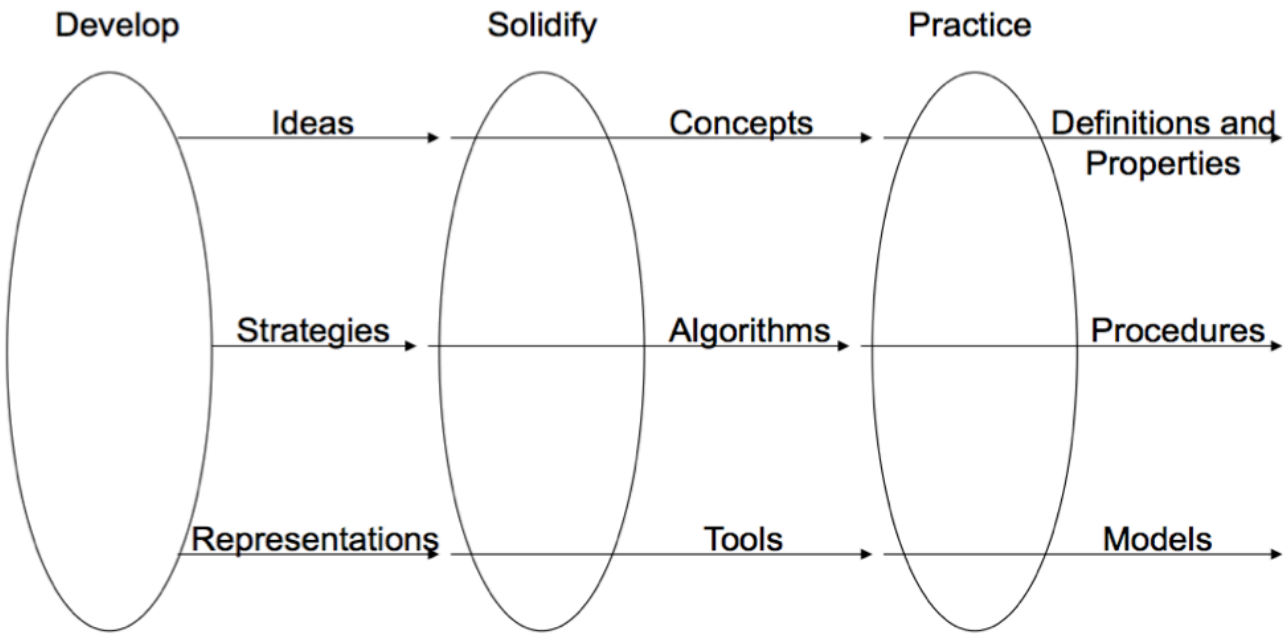
- Examine and clarify the meaning of the nine words using the descriptions and illustrative examples of student work. If two words feel like synonyms, clarify the definitions to distinguish between them.

- Sort the nine words into categories, where the words in each category share common characteristics. Choose a descriptive title for each category.

- Arrange the words in each category in order from *start to finish, beginning to end, naïve to sophisticated, invented to refined*, or some other type of progression.

Unpacking the Mathematics of the Learning Cycle

- What is the conceptual, procedural, and representational understanding that is emerging from the work in the learning cycle?
- How does the mathematical understanding change from the beginning to the end of the learning cycle?
- How does a deeper understanding of the *continuum* support instructional decision making throughout the learning cycle?



Debriefing the Learning Cycle Experience

- How does understanding the learning cycle help teachers to make instructional decisions about selecting and sequencing student work during a lesson?

- How does understanding the continuum help teachers to think about the art of using student thinking to make ideas accessible to all students and also move the class forward?

PROFESSIONAL LEARNING COMMUNITIES AND ASSESSMENT

Using the CMI Framework to inform the work of professional learning communities in designing assessments and responding to student needs.

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Two Key Questions for a Professional Learning Community

- What do we want students to know and be able to do?
- How will we know if they have learned it?

What do we want students to know and be able to do?

- For each task in Secondary Mathematics I, Module 6, write one or two learning targets in student friendly language.

How will we know if they know it?

- **What can we assess after each task?**
- **How does the type of task (Develop, Solidify, Practice) influence our assessment choices?**

Next Steps

- What ideas do you have for advancing your own work in designing assessments and supporting meaningful PLC's?

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INFLUENCING TEACHER BELIEFS AND PRACTICES

Understanding the continuum of teacher beliefs and practices to better support MVP implementation.

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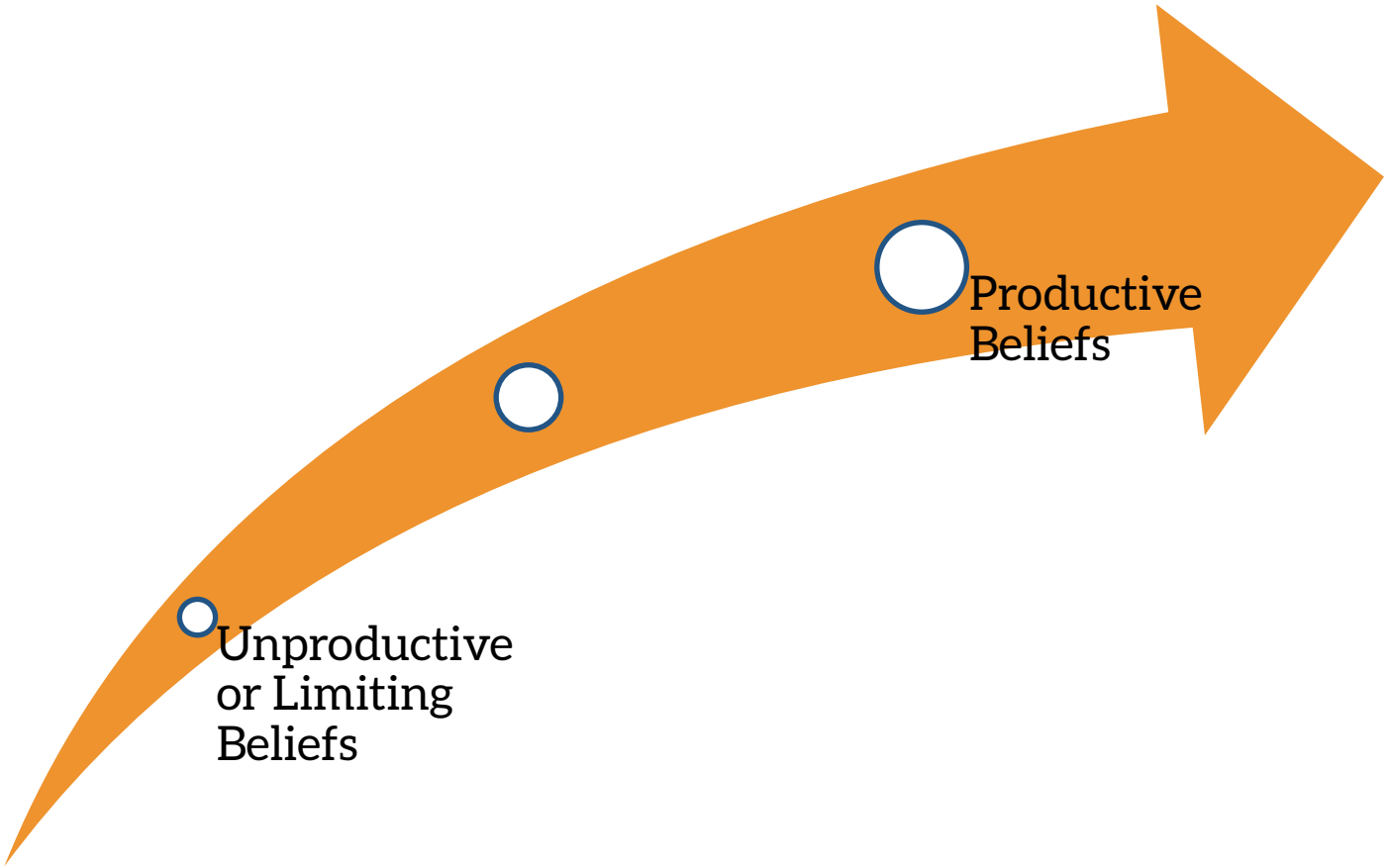
Teacher Beliefs



Continuum of Teacher Practice

	Traditional Instruction	Developing	Solidifying	Practicing
Establishes mathematics goals to focus learning	Teacher has different lesson objectives each day, with the expectation that students have mastered the objective at the end of the lesson.	Teacher uses MVP tasks in order, sometimes spending several days on tasks to be sure that students understand everything in the task.	Teacher knows that ideas will be repeated throughout the learning cycle and has learned not to spend too much time on any one task.	Teacher has clear goals for each task based on an understanding of the progression of the learning cycle. Teacher makes instructional decisions based upon goals.
Implements tasks that promote reasoning and problem solving	Lessons consist of teacher explanations and student practice on routine problems.	Teacher uses a few tasks in each unit along with more traditional lessons.	Teacher uses tasks every day, but isn't always able to facilitate them in a way that builds understanding.	Teacher uses tasks as the primary teaching method, maintaining cognitive rigor and allowing multiple entry points.

Classroom Scenarios

- Read the scenario.
- Identify where each teacher is on the continuum relative to each practice.
- Cite evidence from the scenario to support your assessment of the teacher practice.

Next Steps

- Think about each teacher individually. What high-leverage practice do you think will help that teacher to move along the continuum?

- How can you facilitate the learning of the teachers to move to the next step? What experiences do you create for them?

- How can you support teachers in your context to engage in meaningful self-reflection?

NEW WAYS OF THINKING ABOUT MATHEMATICS

Providing professional learning experience to increase teachers' mathematical knowledge for teaching.

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Drawing on your own experience

- Think about a time when you were a participant in professional development about math content knowledge, either a good experience or one that was not so great.

- Describe your experience to your partner and write down the features of the experience that made it productive or not.

Learning from Student Work Protocol

- We will present the student work and describe the context for the student work
- Barb and Mike will be the other members of the PLC team.
- You will participate by observing. If you want to add something to the conversation move into the empty chair.
- You can tap someone out of the empty chair.

Learning from Student Work Protocol

- What do you see? (Avoid judgments or interpretations)
- From the student's perspective, what is the student working on?
- What are the implications of this work for teaching and assessment?
- For teachers: What insights have you gained from the group discussion?

Digging Into Student Work with the MVP Team

- As you observe the team's interaction, take note of the various ways of looking at the mathematics in the student work.

- What mathematical ideas or strategies is the group drawing upon to understand the student work?

Try it yourself!

Interrogating a Slice of Student Work

Framing Question: What does it mean to say that a function is quadratic?

(May distribute the data so that all student work gets considered.)

Protocol Times:

Part 1 – Examining the work (*take notes in silence*): 10 minutes

Part 2 – Describing the student work (*What do you see?*): 10 minutes

Part 3 – Interpreting the student work (*From the student's perspective, what is the student working on?)*: 15 minutes

Part 4 – Share your thinking (*create poster*): 15 minutes

Part 5 – Debriefing the process: 10 minutes

Share Your Thinking

Select one piece of student work that your group discussed.
Prepare to share by charting:

- Which student work?
- What did you notice?
- What does it mean relative to our framing question?

Debrief the experience

- What ideas about quadratic functions have been highlighted for your as you examined this set of student work?

- What did we learn about examining student work from engaging in this process? How can we improve the process?

Helping teachers to deepen their content knowledge.

- How do you support teachers at getting better at thinking about the mathematics in a way that they weren't taught?

- How do you make sure that content knowledge is a piece that is considered in planning PLC time and professional development?

INFLUENCING TEACHER BELIEFS AND PRACTICES

Strategies to support teachers in successfully implementing the 8 teaching practices.

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Photocopy Faux Pas

A Develop Understanding Task

Teacher Actions

Mathematics Teaching Practices
Establish mathematics goals to focus learning. Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.
Implement tasks that promote reasoning and problem solving. Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.
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.
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.
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.
Build procedural fluency from conceptual understanding. Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.
Support productive struggle in learning mathematics. Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.
Elicit and use evidence of student thinking. Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

Video

Strategies from our Sites

- What supports for teachers have been put in place at your site?
- What other strategies might help teachers move along the teaching continuum?

What's New from MVP?

- Applets
- Enhancements
- Sentence Frames

Next Steps

- Read through the “Lead Like an MVP” document and select one area that is an area of opportunity at your site.
- What actions will you take to improve teaching and learning at your site in this area?