Leveraging the *Connecting Representations* Instructional Routine for student and teacher learning.

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Grace Kelemanik

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AGENDA:

- Framing and background info
- Experience *Connecting Representations*
- Reflect on Math Practice 7
- Experience *Connecting Representations*
- Reflect on Student Supports
- Why is an instructional routine a high leverage tool for coaches and teacher educators?

What's an Instructional Routine?

Instructional Routine

"Designs for interaction that organize classroom activities"

Magdalene Lampert NCSM 2015

Practices are habits and habits are formed through routine.

Instructional Routines
are designed to be repeated

Practices are habits and habits are formed through routine.

Instructional Routines

Are powerful tools for developing math thinking and math teaching practices.

COMMON CORE STATE STANDARDS INITIATIVE

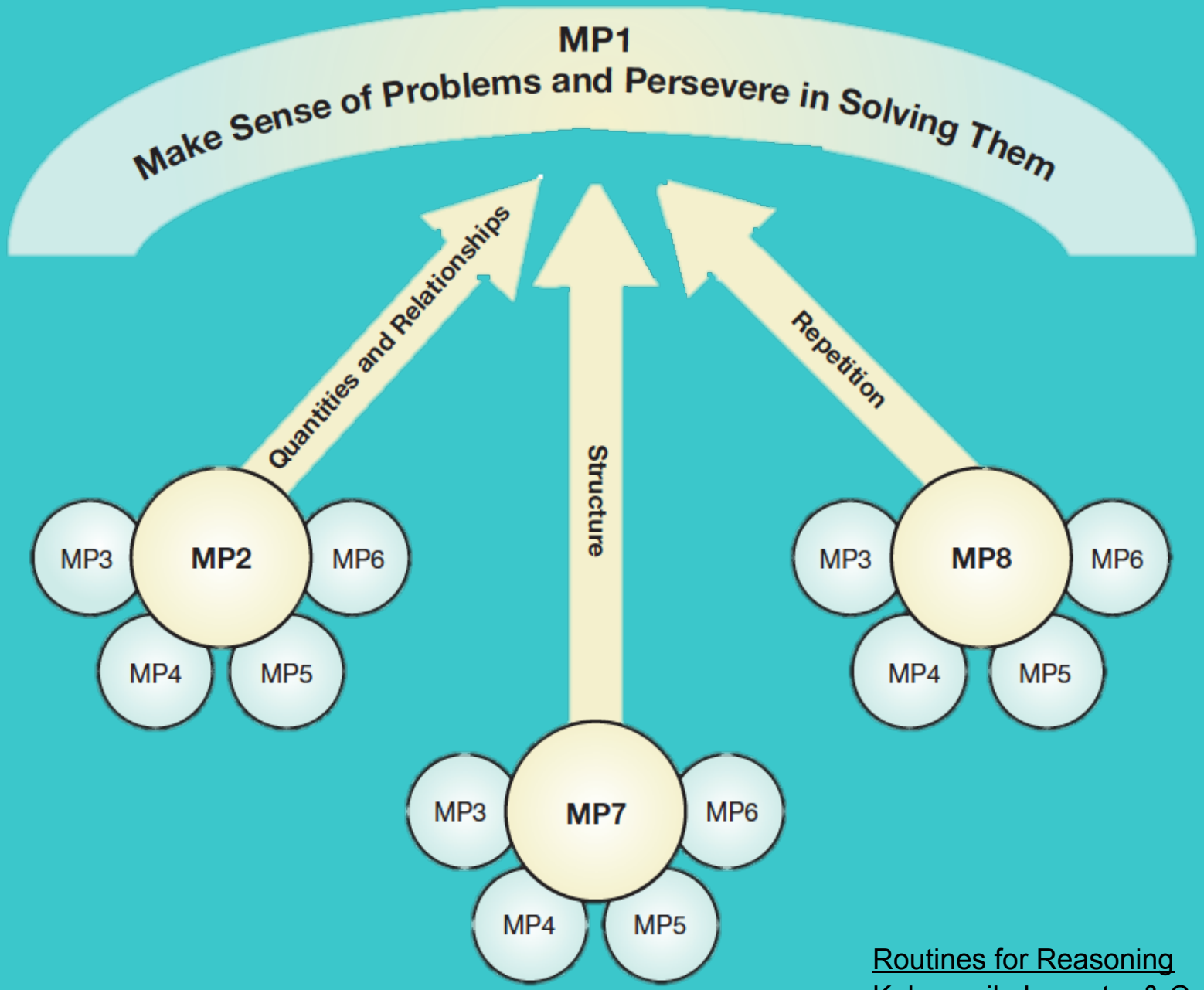
Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Effective Mathematics Teaching Practices

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.

NCTM



Routines for Reasoning
Kelemanik, Lucenta, & Creighton

Structural Thinking (MP7)

Attend to…

Organization

and

Properties

of

Number and Space

Ask Yourself…

- How can I *chunk* this to make sense of it?
- How can I *change* the form to make it easier to work with?
- Can I *connect* this to something else I know?
- How can I use properties to uncover structure?

Put into Action

- *Chunk* complicated objects
- *Change* the form of objects
- *Connect* math ideas & representations
- Recall and use properties, rules of operations and geometric relationships

Connecting Representations

An Instructional Routine to Develop
ALL Students' Structural Thinking

Routines for Reasoning
Kelemanik, Lucenta, & Creighton

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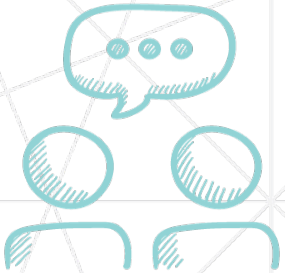
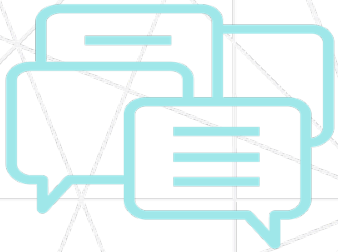
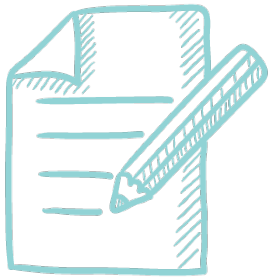
Connecting Representations

WHAT: Match visuals to expressions by **chunking**, **changing** the form, and **connecting** to math you know

WHY: To "think like mathematicians", to use mathematical *structure* to match two different representations.

Connecting Representations



Think

Make connections

Share & study connections

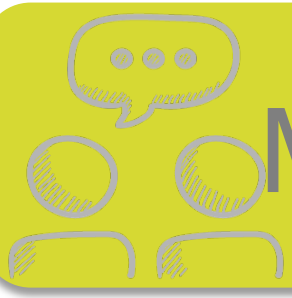
Create representation

Reflect on learning

Think

Ask yourself…

- What part of the *visual* will help me connect to a chunk of the *expression*?
- What about the *expression* will help me connect to the *visual*?

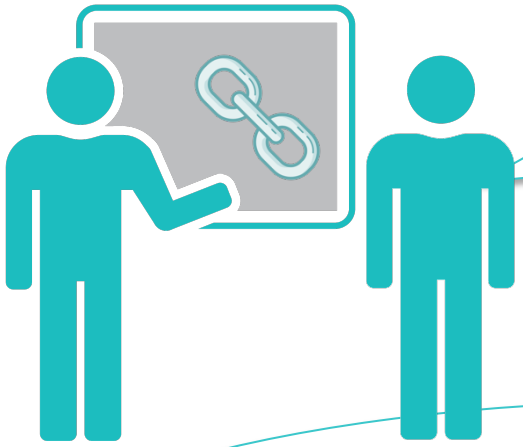


Make Connections

“I saw… so I connected...”

“... connects to ... because...”

Share & Study Connections



We noticed… so we ...
We knew... so we...

They noticed… so they ...
They knew... so they...

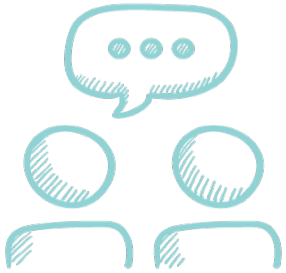
Create a Representation

THINK

Ask yourself…

- "What do you notice about this *expression*?"
- "How can you chunk this *expression* into pieces you can describe?"

Create a Representation



Pair

- Share your interpretations of the *expression*.
- Together create a matching *visual representation*.

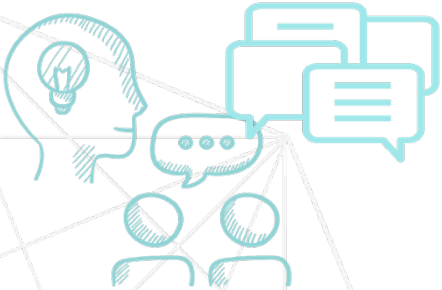
Create a Representation

Share

They noticed… so they…

When they saw…it made them think of… so they…

Meta-Reflection

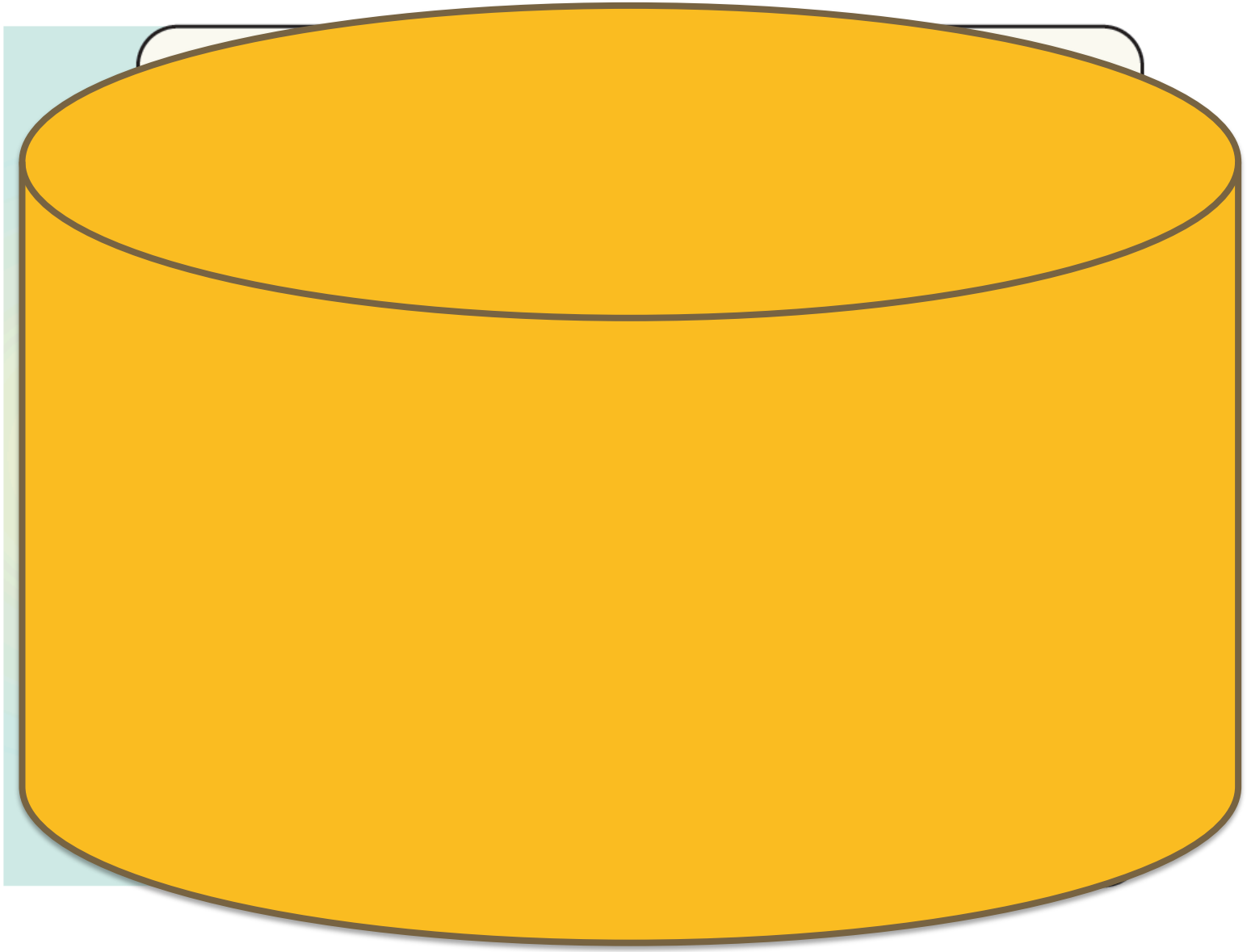


A. When interpreting an *expression / visual*, I learned to pay attention to…

B. When connecting representations, I learned to ask myself…

C. A new mathematical connection I made is…

Connecting Representations Container



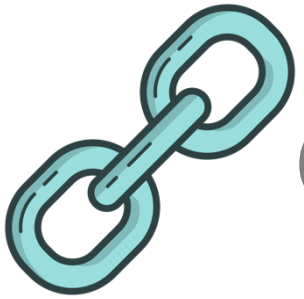
Reflect on CR Instructional Routine

What stands out to you about the Connecting Representations instructional routine?

What questions do you have?

MP7 in Connecting Representations

- MP7 Goal
  - To learn to “think like a mathematician” by connecting two things that look nothing alike at all, but represent the same underlying structure.
- Task selection that invites structural thinking
- Questions that orient attention to structure
  - What are the pieces of the visual and how do they connect to the rule?
  - How can you make sense of those pieces?
  - What do those operations imply?
- Meta-cognitive reflection focused on structure
  - I noticed…..so, I looked for….
  - ____ reminded me of ____

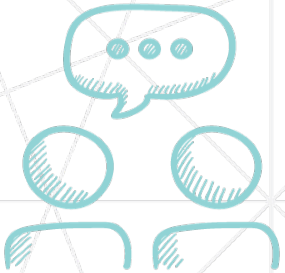
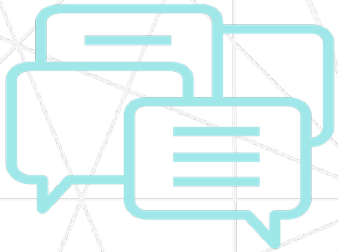


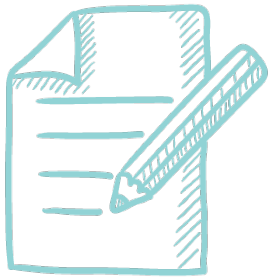
Connecting Representations

WHAT: Match words (verbal description) to graphs by **chunking**, **changing** the form, and **connecting** to math you know

WHY: To "think like mathematicians", to use mathematical *structure* to match two different representations.

Connecting Representations



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Share & study connections

Create representation

Reflect on learning

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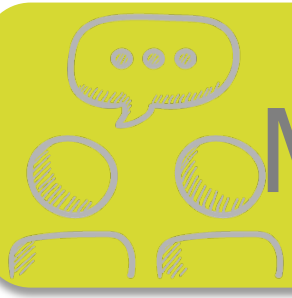
- What about the *graph* will help me connect to the *words*?



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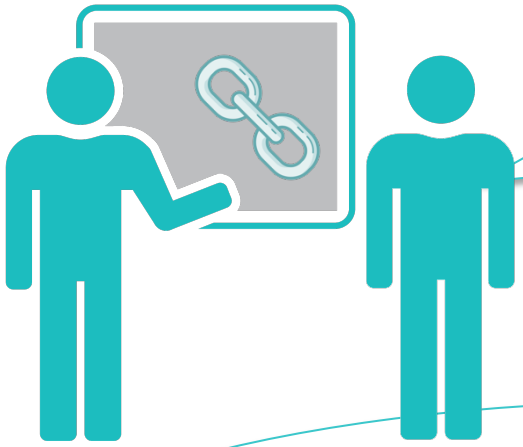

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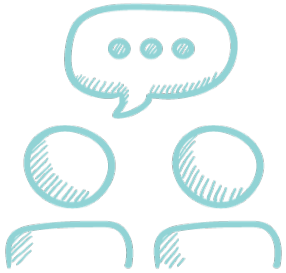

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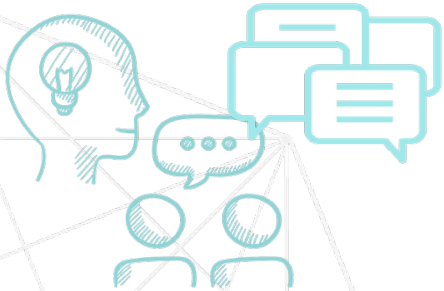


A. When interpreting a *graph/ description*, I learned to pay attention to…

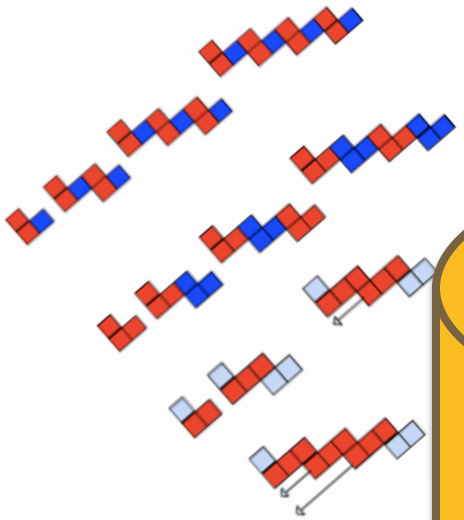
B. When connecting representations, I learned to ask myself…

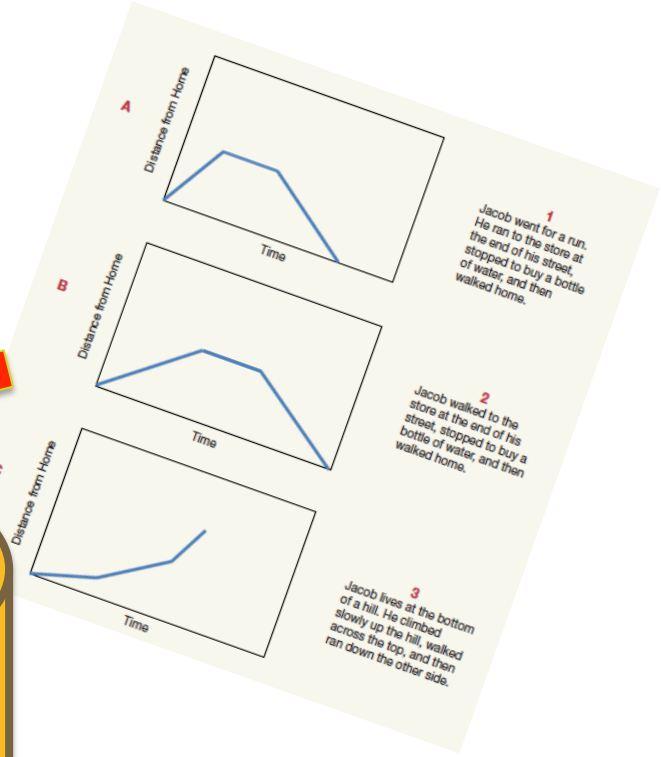
C. A new mathematical connection I made is…

$2(x^2y^2)^3$ The product of x-squared and y all raised to the third power, times 2

$(2x^2y^2)^3$ The product of 2x-squared and y all raised to the third power

$(2x^2)^3y$ The product of 2 and x-squared all raised to the third power, times y

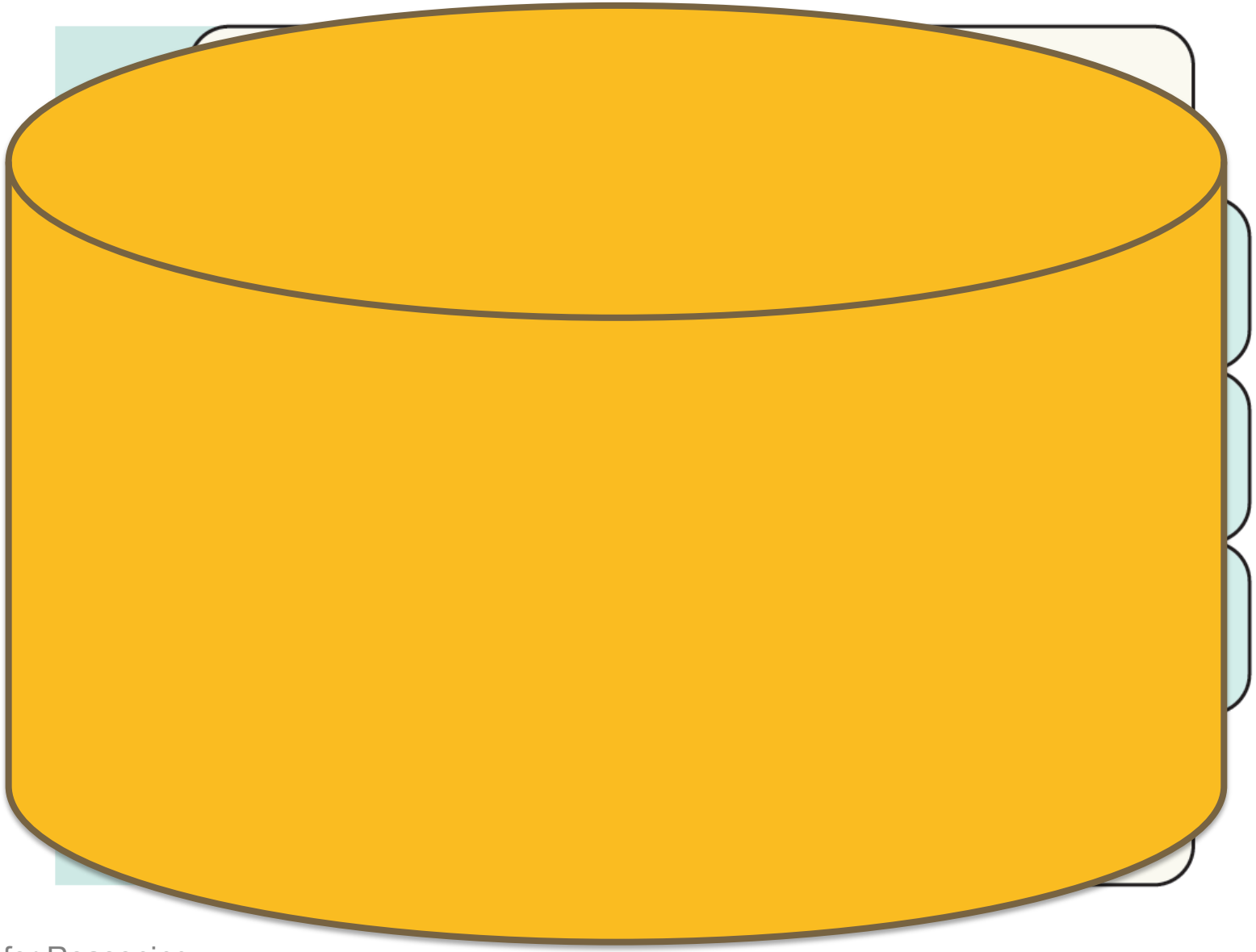




Connecting Representations Instructional Routine

Routines for Reasoning
Kelemanik, Lucenta, & Creighton

Connecting Representations Container

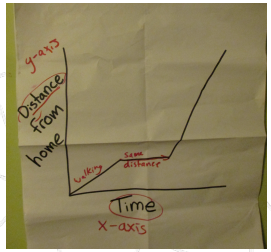


Reflect on CR Instructional Routine

How does/can the Connecting Representations instructional routine provide access and support for SWLD to develop the math practices?

Essential Strategies

Annotation

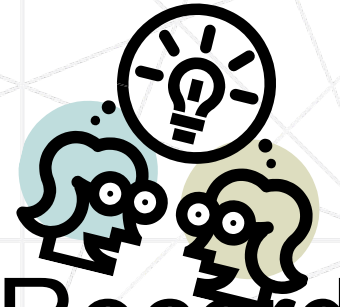


Next time I will…. before I calculate because

Paying attention to… is helpful because…

Sentence Starters/Frames

Four Rs: Repeat, Rephrase, Reword, Record



Ask Yourself Questions

Baked-In Supports for Students with Learning Disabilities within Connecting Representations

- Provide **multiple passes** at articulating the underlying structure between representations using the **Four Rs.**

- Reference **sentence frames and starters** to prompt students to articulate observations that sparked the structural thinking and that can be applied again in other math problems.

- Use **annotation** to make structural connections explicit for students and to provide visual residue of the mathematical discussions.

- Choose **representations** that support students' learning strengths.

- Support students' participation in full-group discussions by defining **partner roles.**

Routines for Reasoning
Kelemanik, Lucenta, & Creighton, p. 86-87

Baked-In Supports for ELLs within Connecting Representations

- Use **sentence starters and sentence frames** to develop structural language (e.g chunk, change, connect) and help students communicate structural elements of representations.

- Make use of the **Four Rs** to provide multiple opportunities to develop and refine academic language crucial for describing structural connections among representations.

- Ensure that **gestures and annotation** support the structural ideas and language and thinking that is being communicated verbally.

Routines for Reasoning
Kelemanik, Lucenta, & Creighton, p. 86-87

The Power of Routines

Instructional routines…

- support students
- are collaborative.
- free up brain space for the hard work.
- serve as vehicles for the Five Practices.
- save time.
- develop math practices over time.
- Wash, rinse, repeat.

….AND….

- Develop equitable practice in a classroom, school, district.

Why are Instructional Routines High Leverage Tools for Teacher Educators /Coaches?

A Rationale

Instructional Routines: High Leverage Tools for Teacher Educators & Coaches

Teaching students to think and reason mathematically requires requires learning experiences that, among other things, position students to:

- "Engage with challenging tasks that involve active meaning making and support."
- "Construct knowledge socially through discourse, activity, and interaction related to meaningful problems."

-NCTM Principles to Action, page 9

Instructional Routines: High Leverage Tools for Teacher Educators & Coaches

Creating and facilitating these types of learning experiences require certain high leverage teaching practices, e.g. NCTM Effective Math Teaching Practices.

- Establish mathematics goals to focus learning
- Implement tasks that promote reasoning and problem solving
- Use and connect mathematical representations
- Facilitate meaningful mathematical discourse
- Pose purposeful questions
- Build procedural fluency from conceptual understanding
- Support productive struggle in learning mathematics
- Elicit and use evidence of student thinking

Instructional Routines: High Leverage Tools for Teacher Educators & Coaches

For many using these teaching practices will mean developing different teaching muscles.

- Establish mathematics goals to focus learning
- Implement tasks that promote reasoning and problem solving
- **Use and connect mathematical representations**
- **Facilitate meaningful mathematical discourse**
- **Pose purposeful questions**
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Instructional Routines: High Leverage Tools for Teacher Educators & Coaches

Instructional Routines: High Leverage Tools for Teacher Educators & Coaches

Why are Instructional routines powerful vehicles for building teaching muscles and developing teaching practices?

- They are *predictable.*
- They're *routine*, therefore provide repeated practice

Instructional Routines: High Leverage Tools for Teacher Educators & Coaches

They allow everyone to focus on high leverage teaching practices

- Establish mathematics goals to focus learning
- Implement tasks that promote reasoning and problem solving
- **Use and connect mathematical representations**
- **Facilitate meaningful mathematical discourse**
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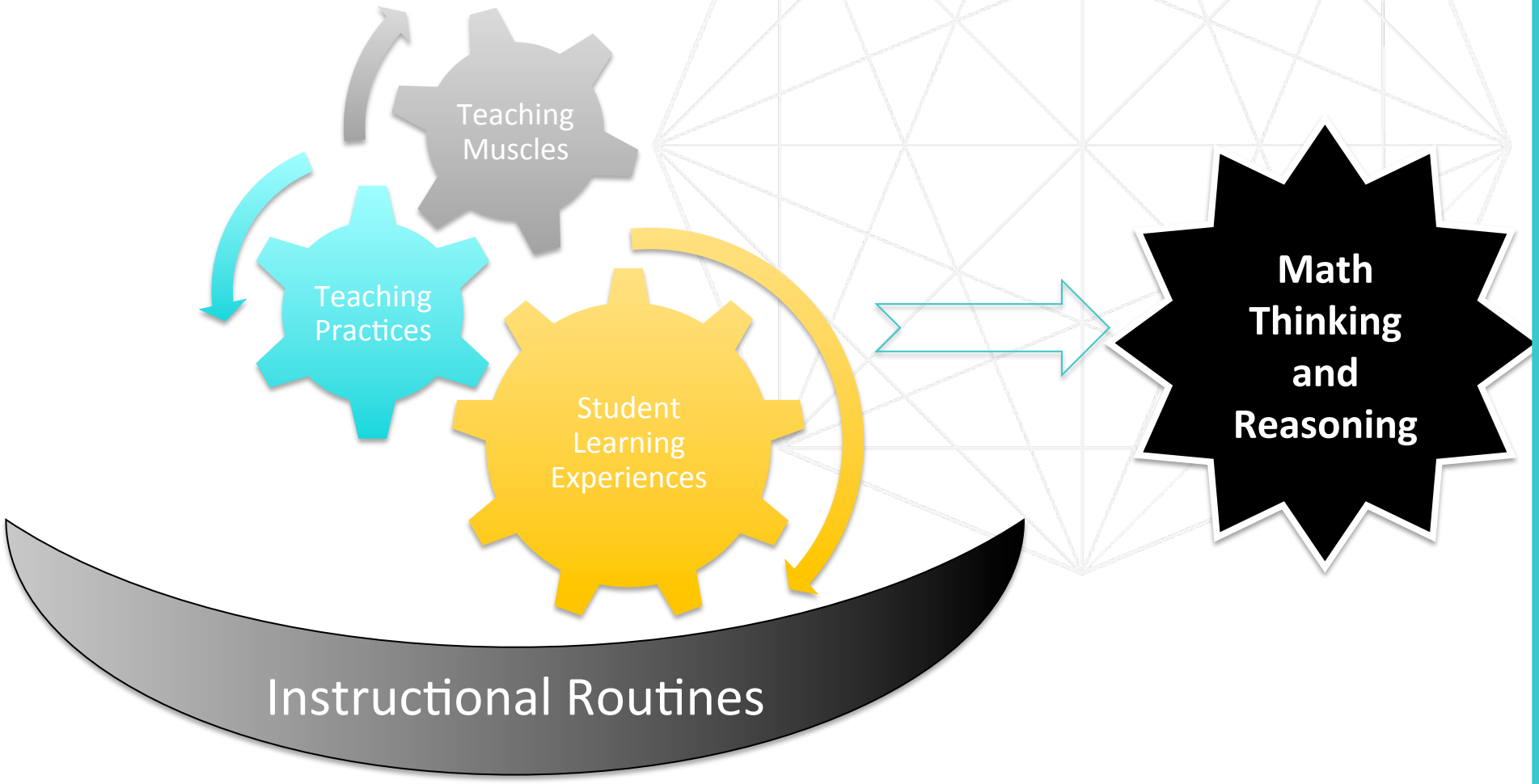
Instructional Routines: High Leverage Tools for Teacher Educators & Coaches



How do you….

- Teach to the standards for mathematical practice?
- Ensure that ALL students-- including ELLs and students with learning disabilities— develop math practices?
- Shift and/or refine teaching practices?
- Increase collaboration between and among colleagues?
- Support coaching practices?

Instructional Routines…

- Develop the standards for mathematical practice,
- In ALL students-- including ELLs and students with learning disabilities.
- Help teachers develop NCTM's eight mathematical teaching practices.
- Support teacher collaboration.
- Support the work of coaches.

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Avenues of Thinking | Special Populations | Routines for Reasoning | Related Resources | What We Offer

"Teaching students to think and reason is perhaps the greatest challenge we face math educators, and these routines pro clear pathways to do so."

For More on Connecting Representations & Other Instructional Routines

Reach Out

AmyLucenta@gmail.com GraceKelemanik@gmail.com

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