

# Designing Instructional Routines to Support the Math Practices

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#FosteringMPs  
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**MATH**  
**PRACTICES**

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Share...discuss...reflect..



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#EPSOBO

@AmyLucenta

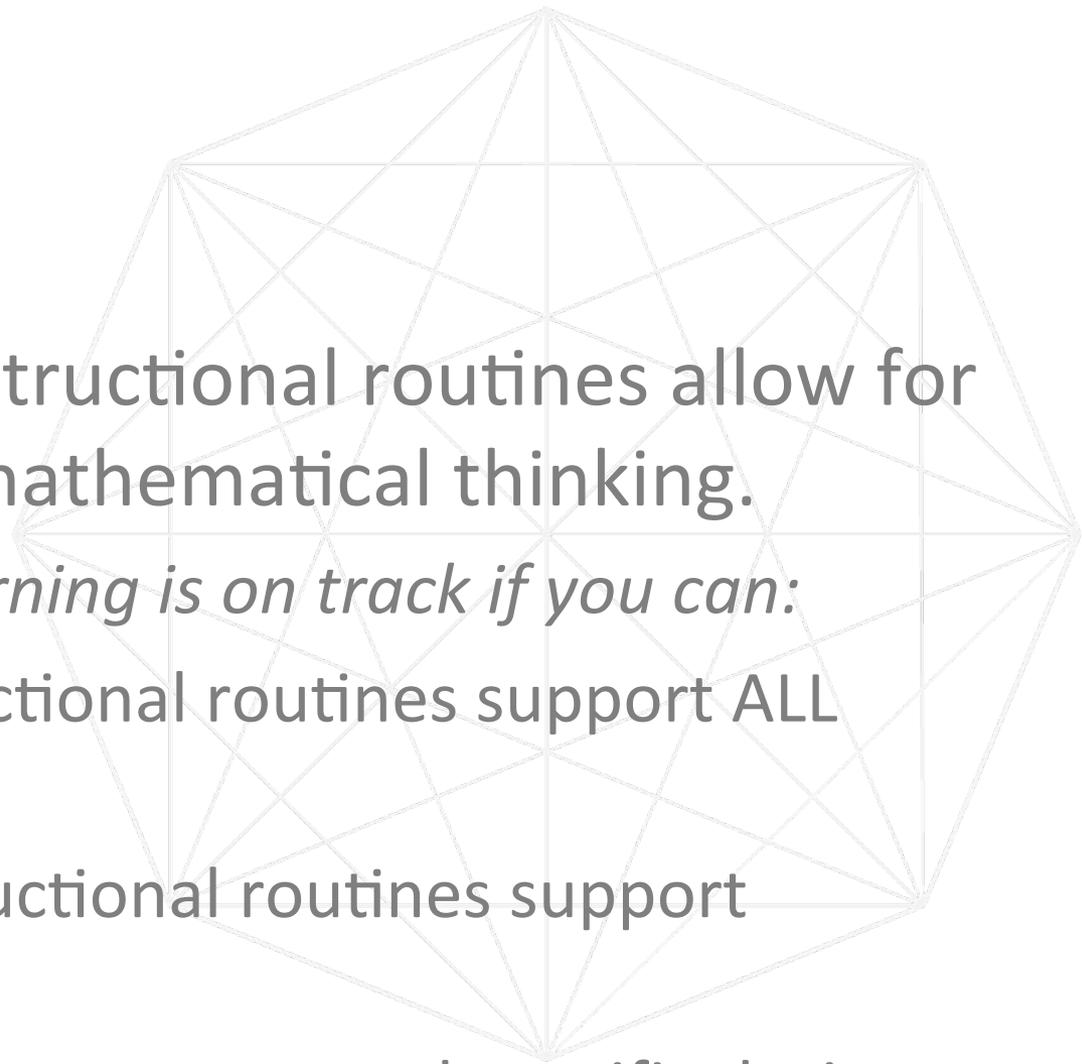
@GraceKelemanik

# Goal # 1

Understand how instructional routines allow for a greater focus on mathematical thinking.

*You will know your learning is on track if you can:*

- Describe how instructional routines support ALL learners.
- Articulate how instructional routines support teachers.
- Describe essential components and specific designs of instructional routines that support student learning

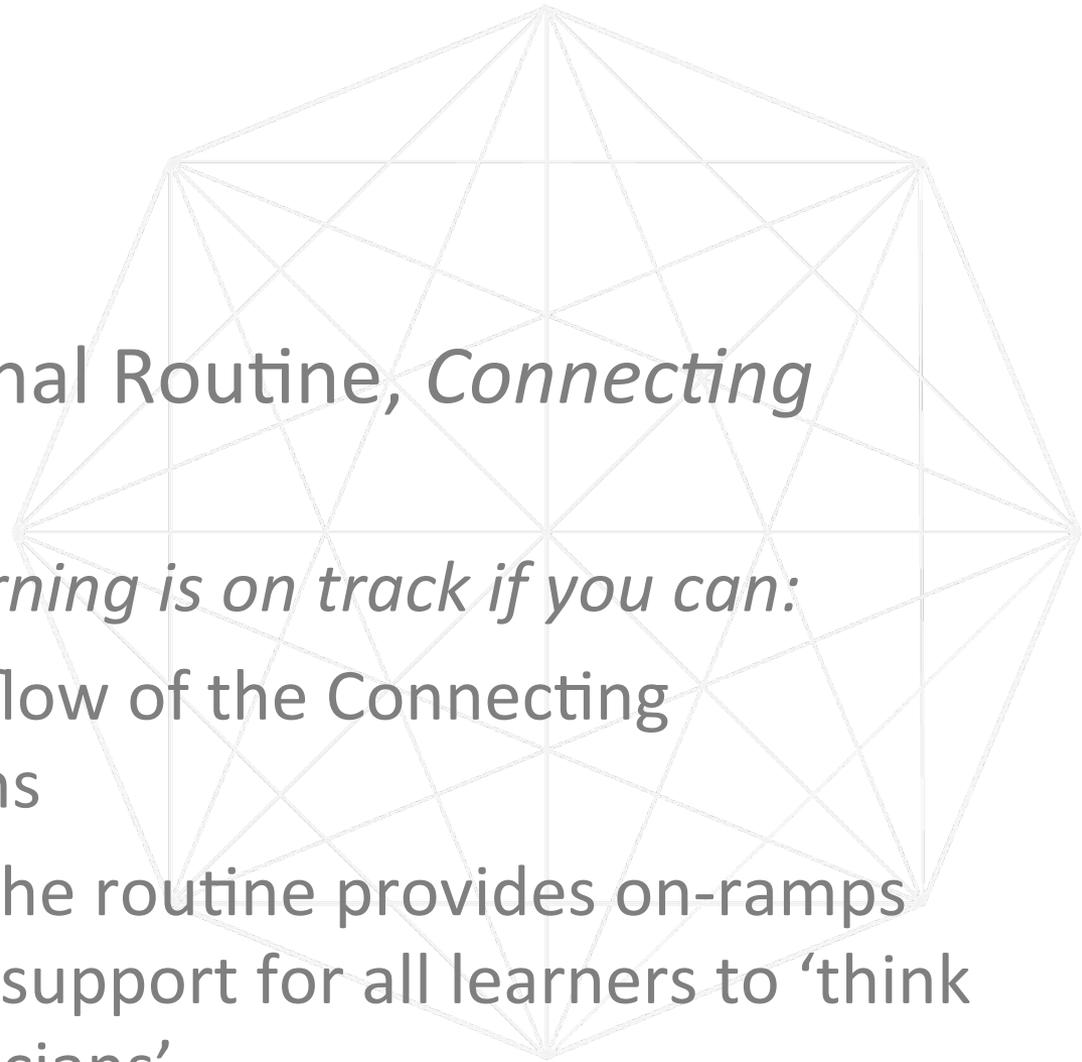


## Goal # 2

Learn the Instructional Routine, *Connecting Representations*.

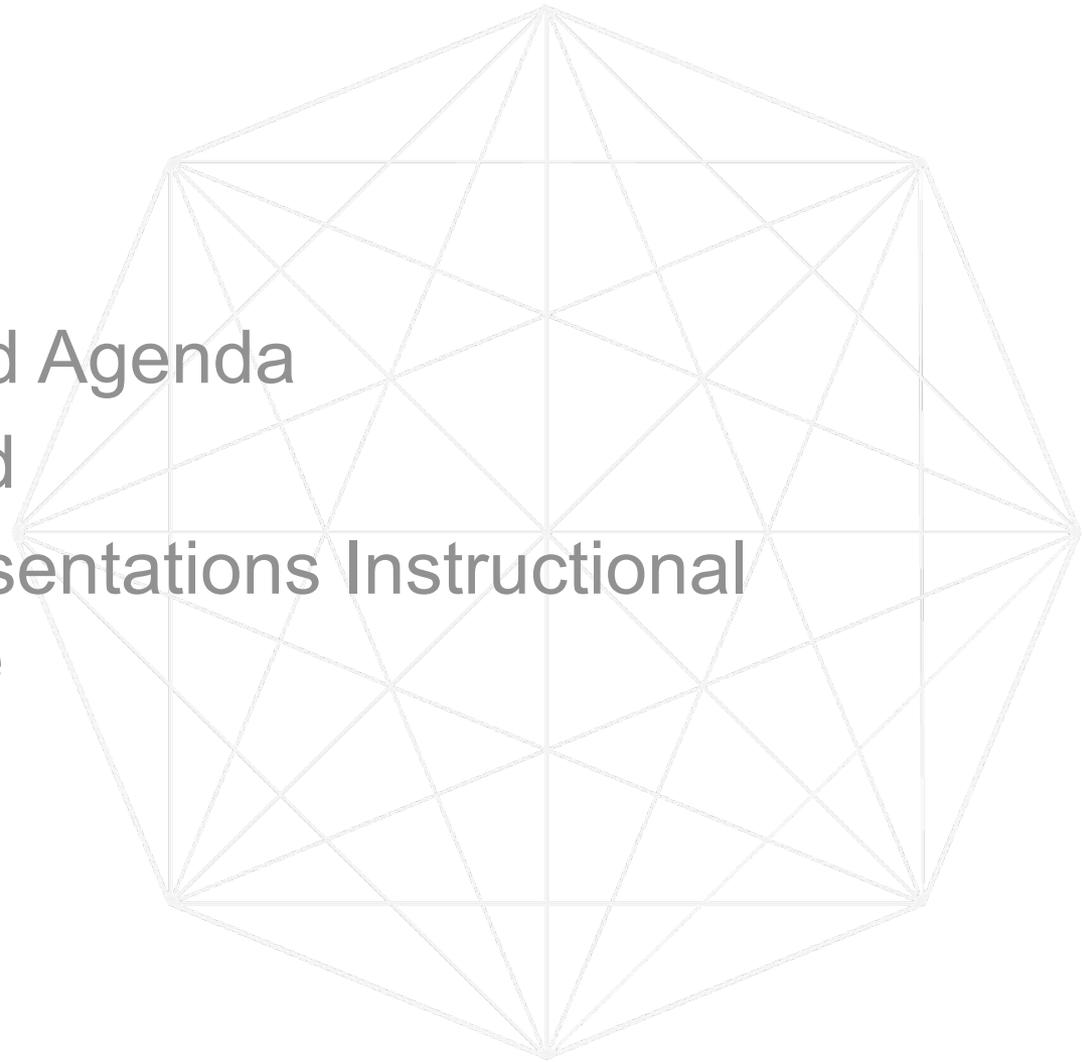
*You will know your learning is on track if you can:*

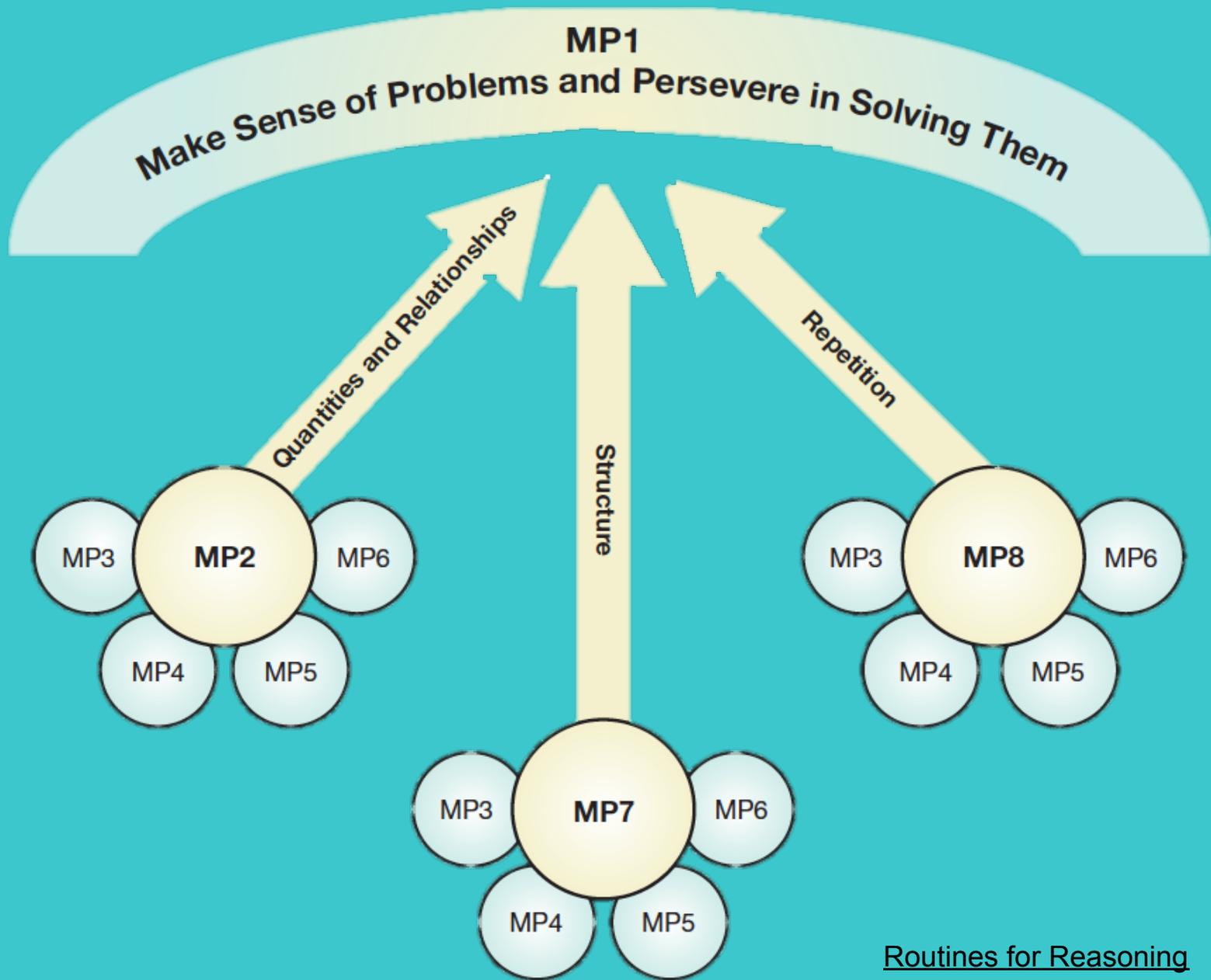
- Articulate the flow of the Connecting Representations
- Describe how the routine provides on-ramps and continued support for all learners to ‘think like mathematicians’

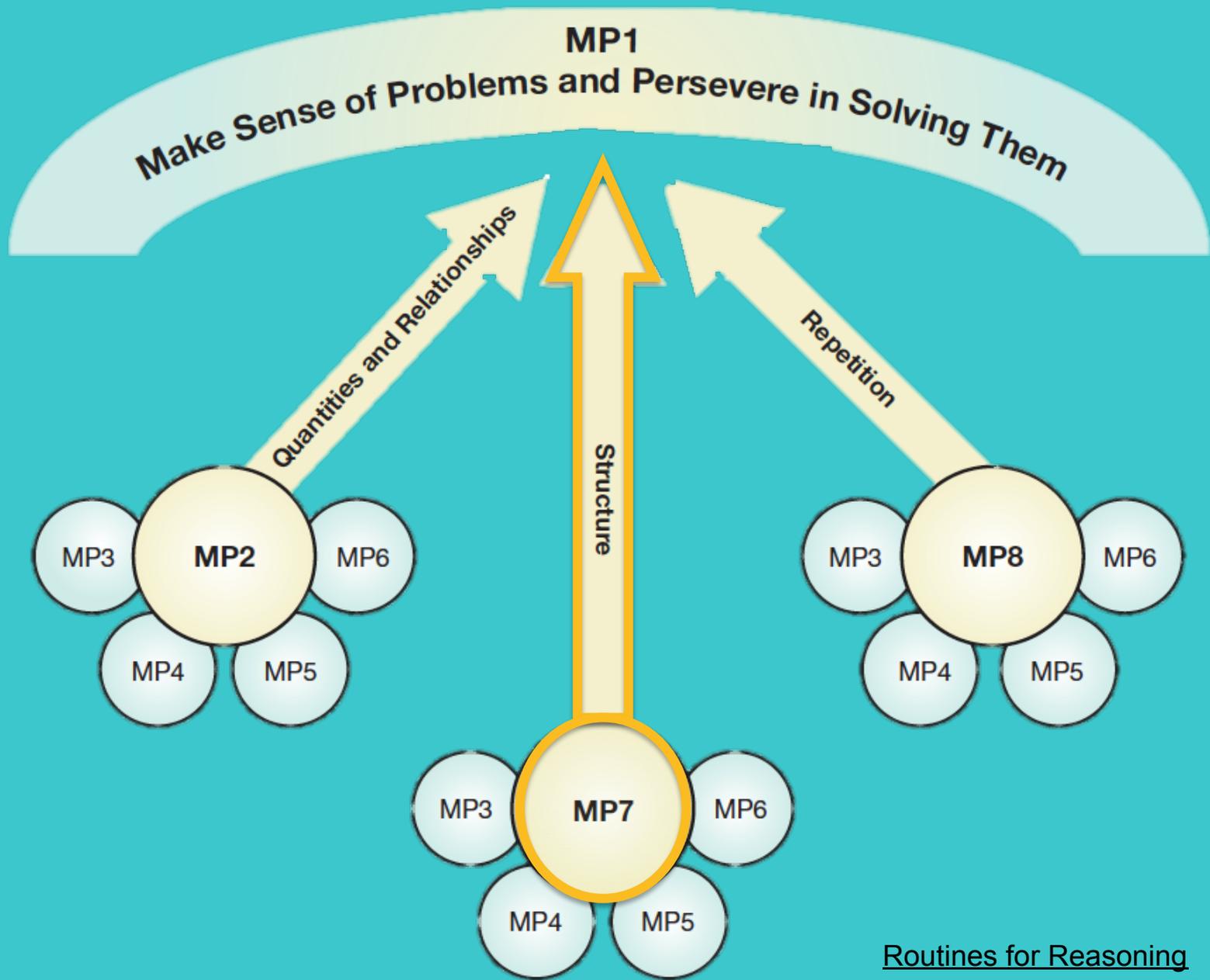


# Agenda

- Opening Goals and Agenda
- A bit of background
- Connecting Representations Instructional Routine Deep Dive
- Selecting Tasks
- Next Steps







# 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

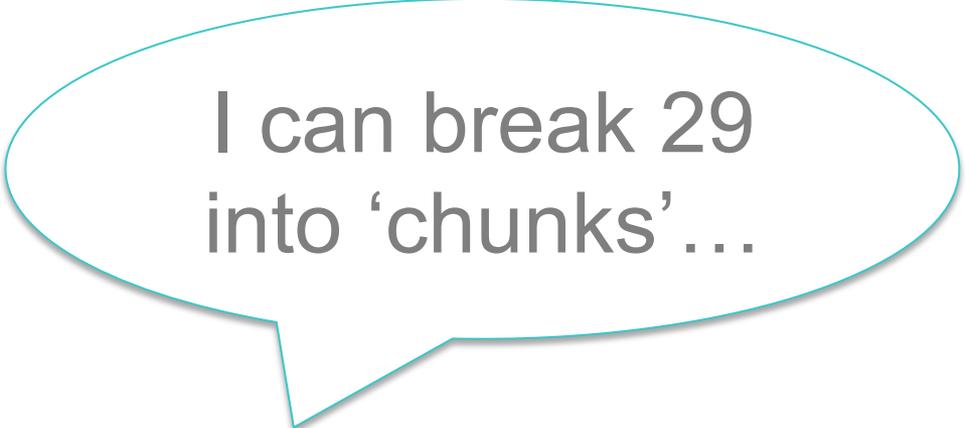
- *Chunk* complicated objects
- *Change* the form of objects
- *Connect* math ideas & representations
- Recall and use properties, rules of operations and geometric relationships

Let's play with mathematical structure and  
identify structural thinking

**Find the value of the expression  
“in your head”**

$$29 \times 5$$

$$29 \times 4$$



I can break 29  
into 'chunks'...

$$4 \times 29$$

$$4 \times (20+9)$$

$$4 \times 20 + 4 \times 9$$

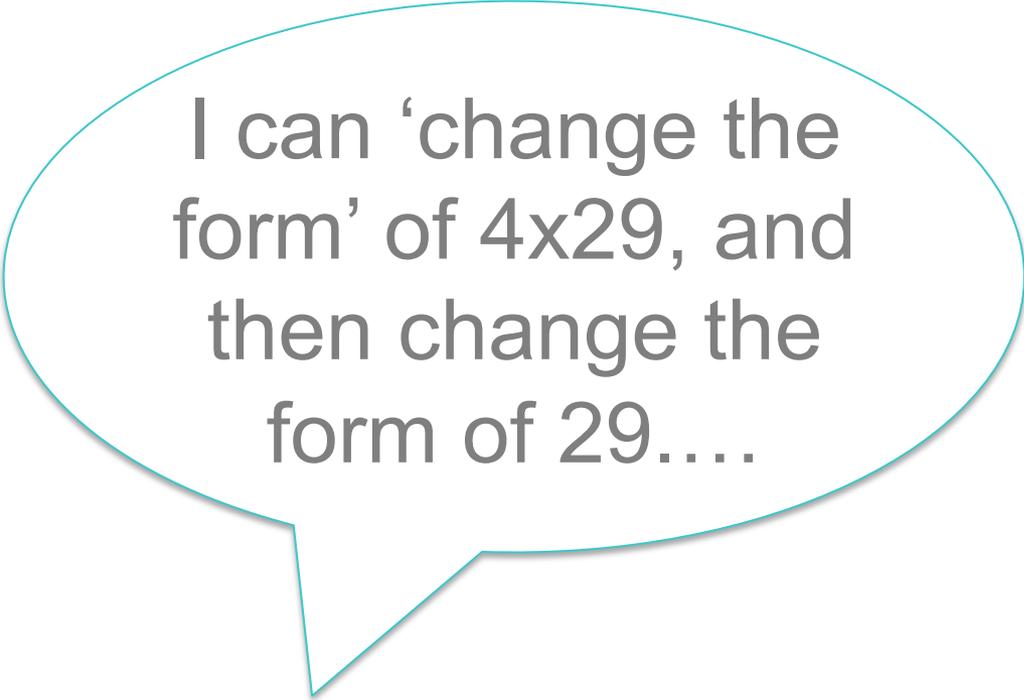
$$4 \times 29$$

$$29 \times 4$$

$$4 \times (30 - 1)$$

$$4 \times 30 - 4 \times 1$$

$$4 \times 30 - 4 \times 1$$



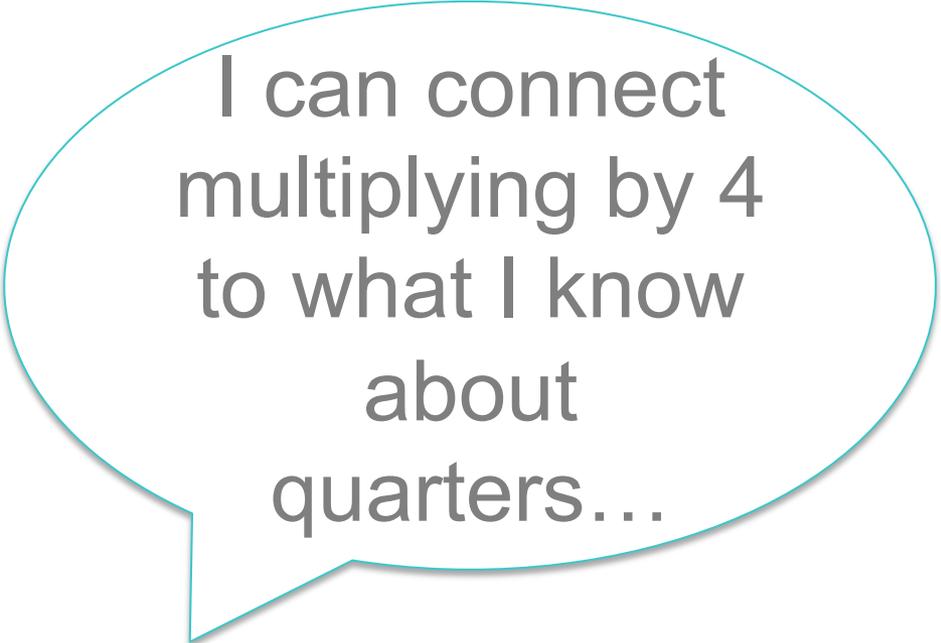
I can 'change the form' of  $4 \times 29$ , and then change the form of 29....

$$29 \times 4$$

$$25 \times 4 = 100$$

$$4 \times 4 = 16$$

$$4 \times 25 + 4 \times 4$$



I can connect  
multiplying by 4  
to what I know  
about  
quarters...

# Structural Thinking Shifts

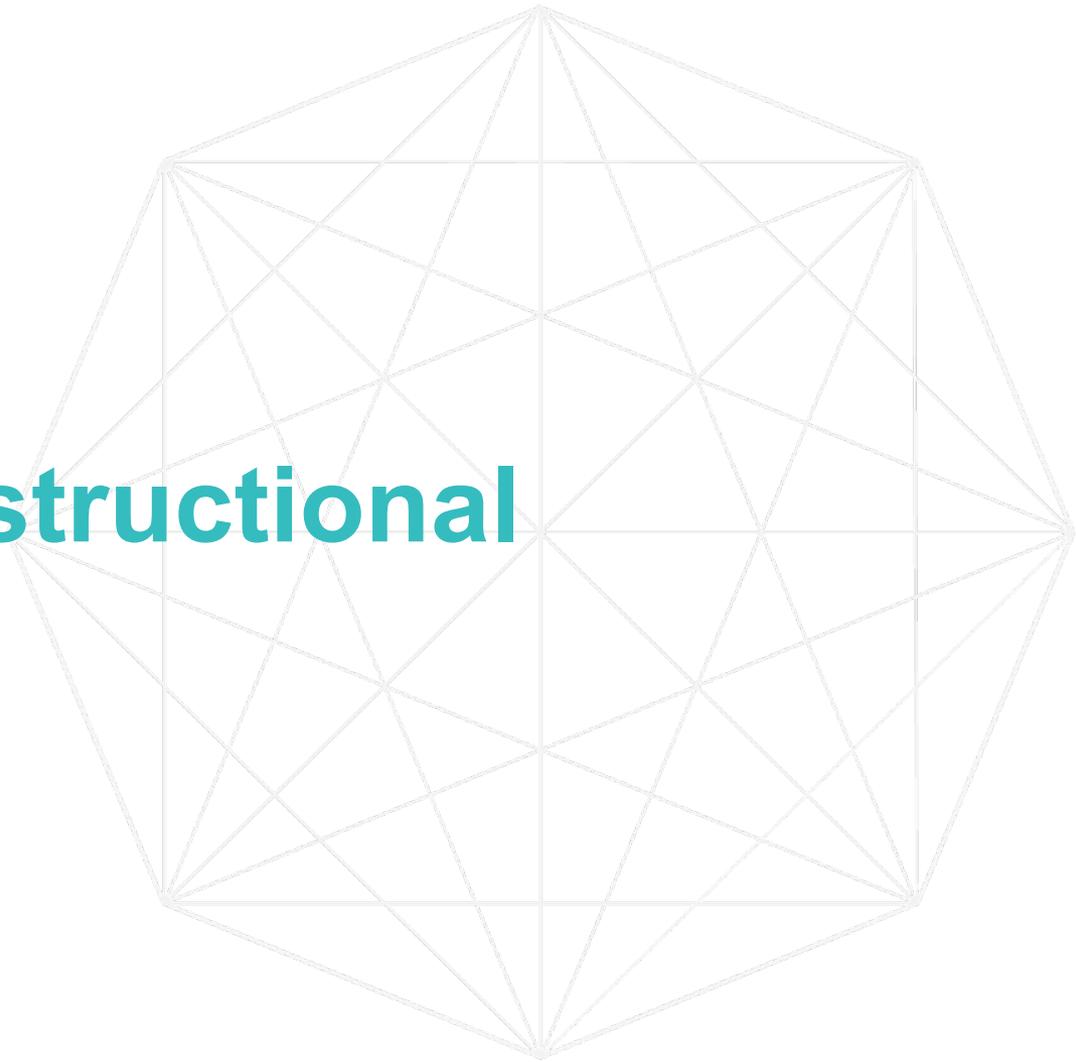
**An unrelated  
collection  
of results  
and procedures  
to know**

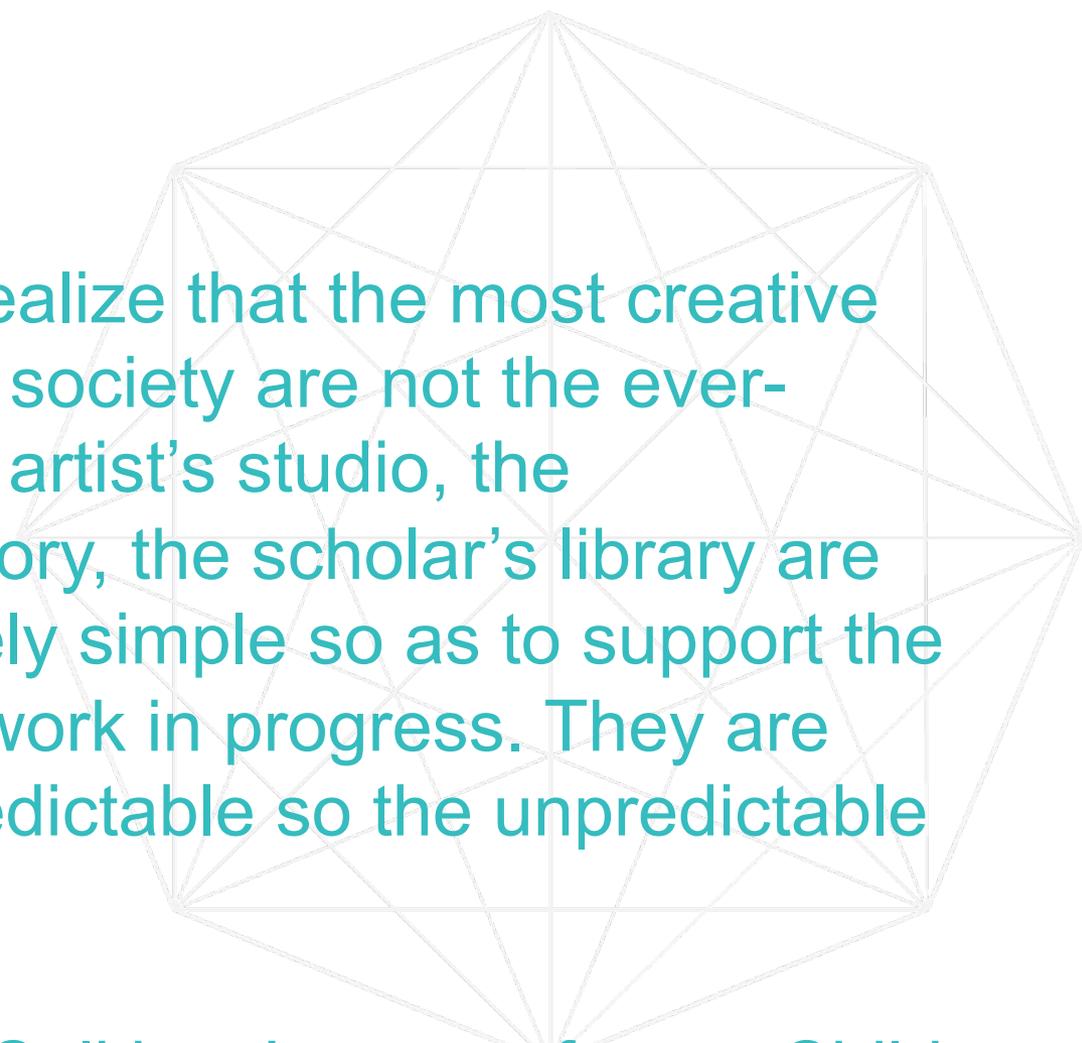


**A set of  
interconnected  
ideas that build  
on each other  
and make sense**

# Why Teach In, Through, and With Mathematical Structure?

# What's an Instructional Routine?



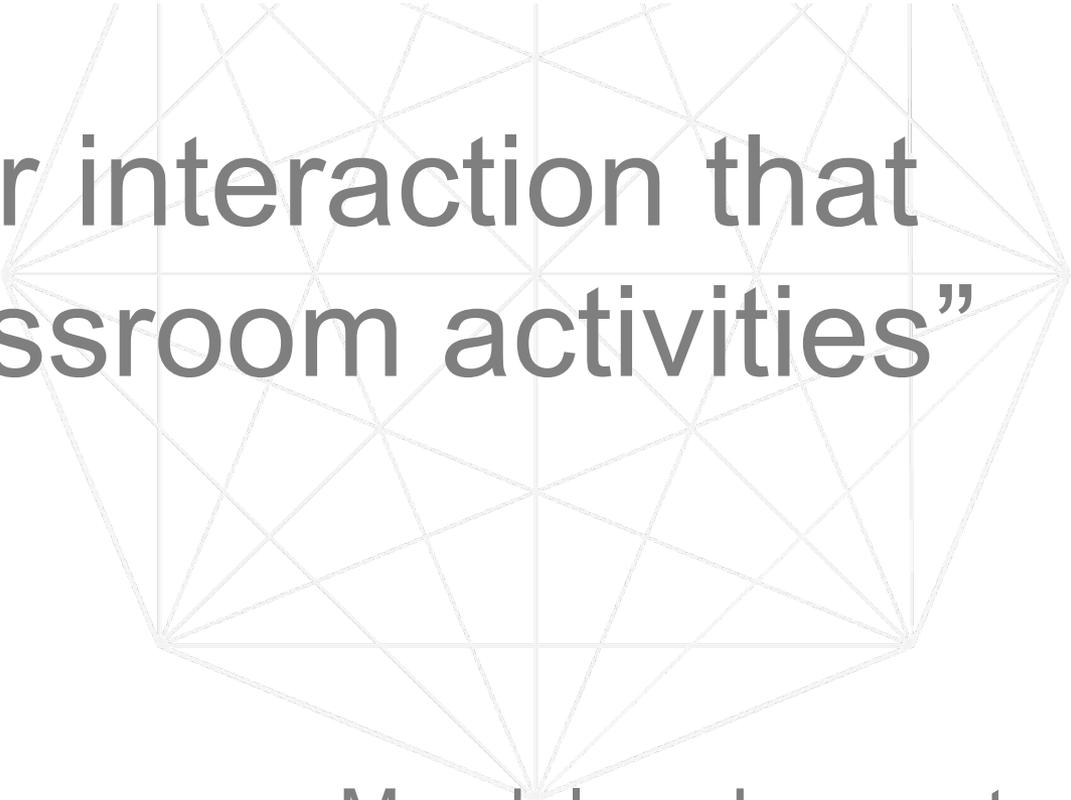


“ It is significant to realize that the most creative environments in our society are not the ever-changing ones. The artist’s studio, the researcher’s laboratory, the scholar’s library are each kept deliberately simple so as to support the complexities of the work in progress. They are deliberately kept predictable so the unpredictable can happen.”

—Lucy Calkins, *Lessons from a Child*

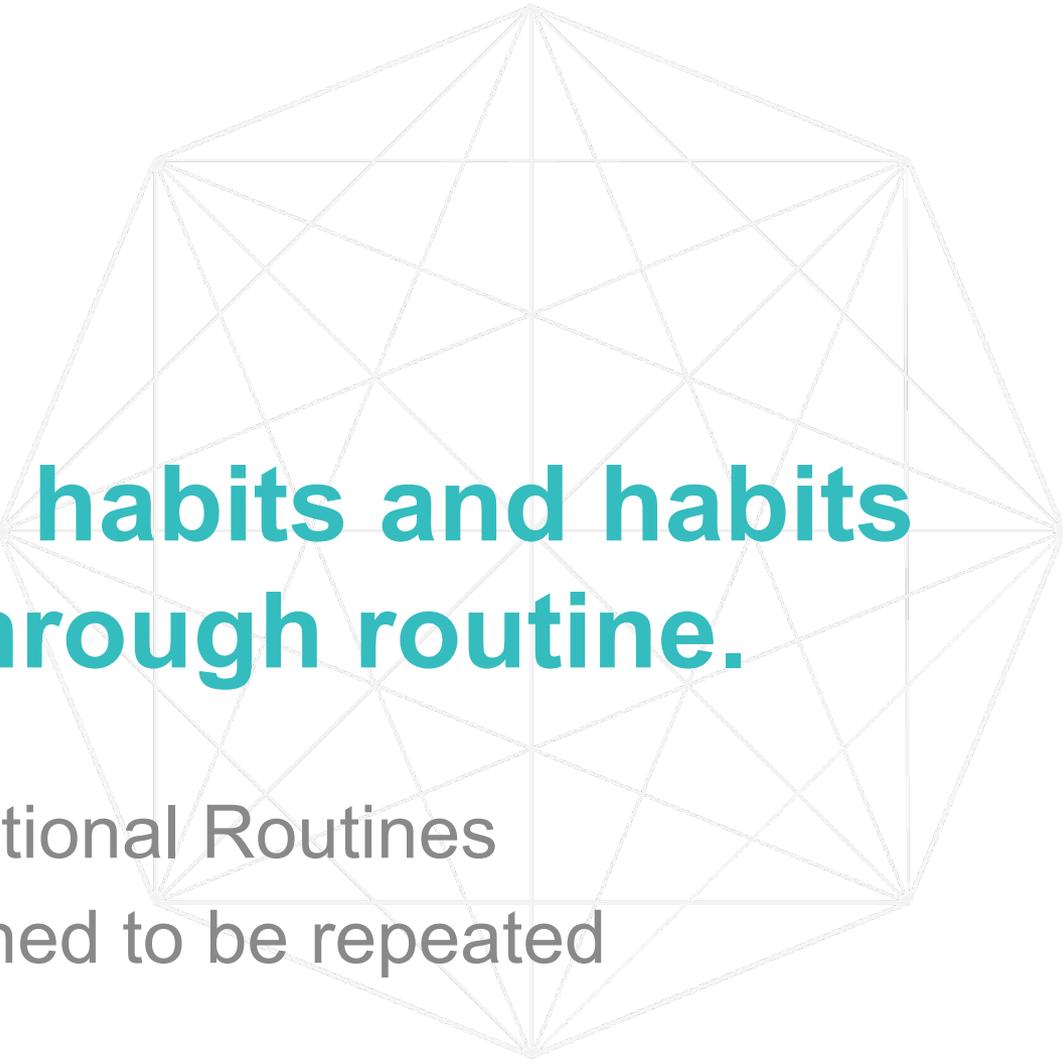


# Instructional Routine



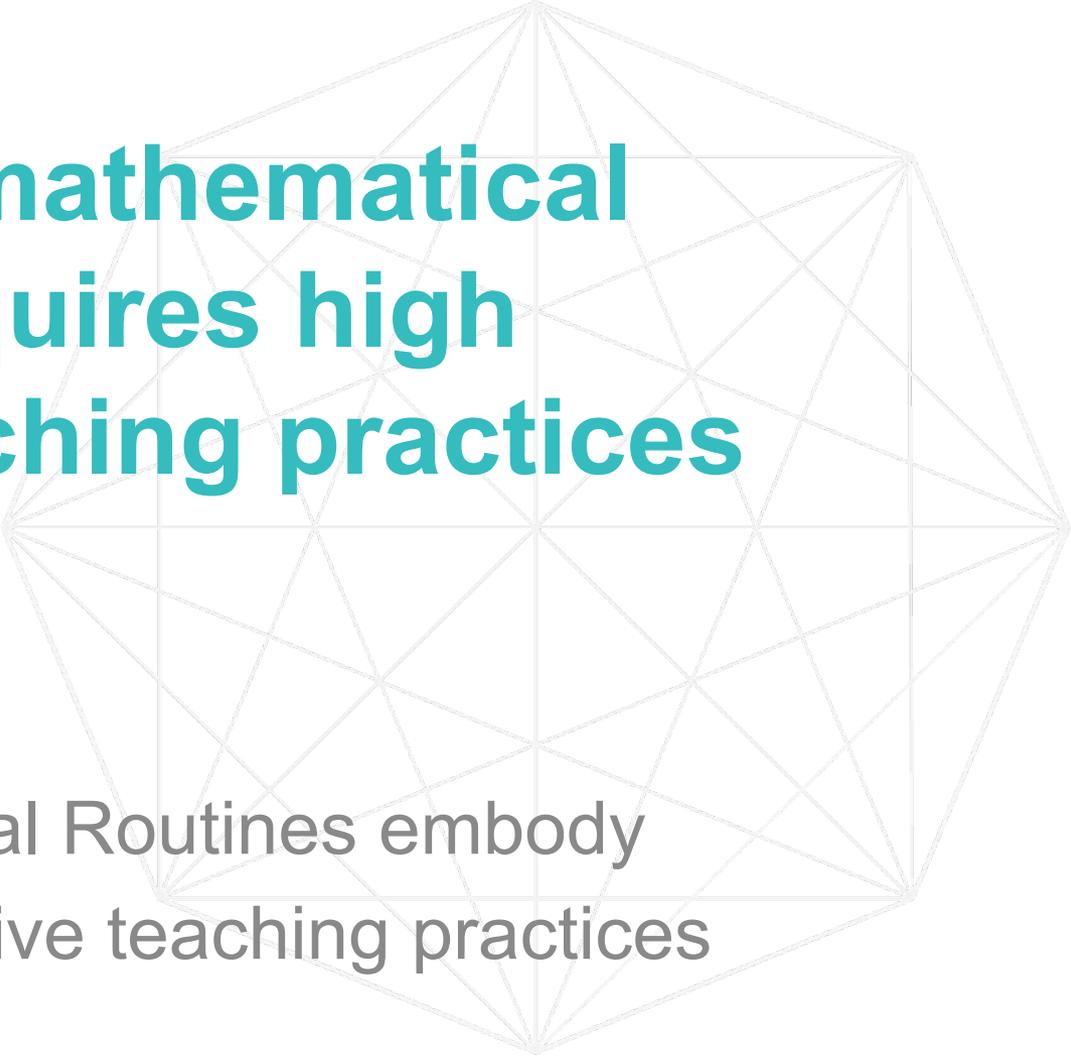
“Designs for interaction that  
organize classroom activities”

Magdalene Lampert  
NCSM 2015



**Practices are habits and habits  
are formed through routine.**

Instructional Routines  
are designed to be repeated

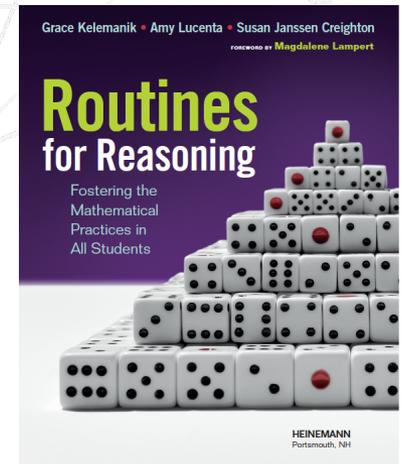


# Developing mathematical practices requires high leverage teaching practices

Instructional Routines embody  
NCTM effective teaching practices

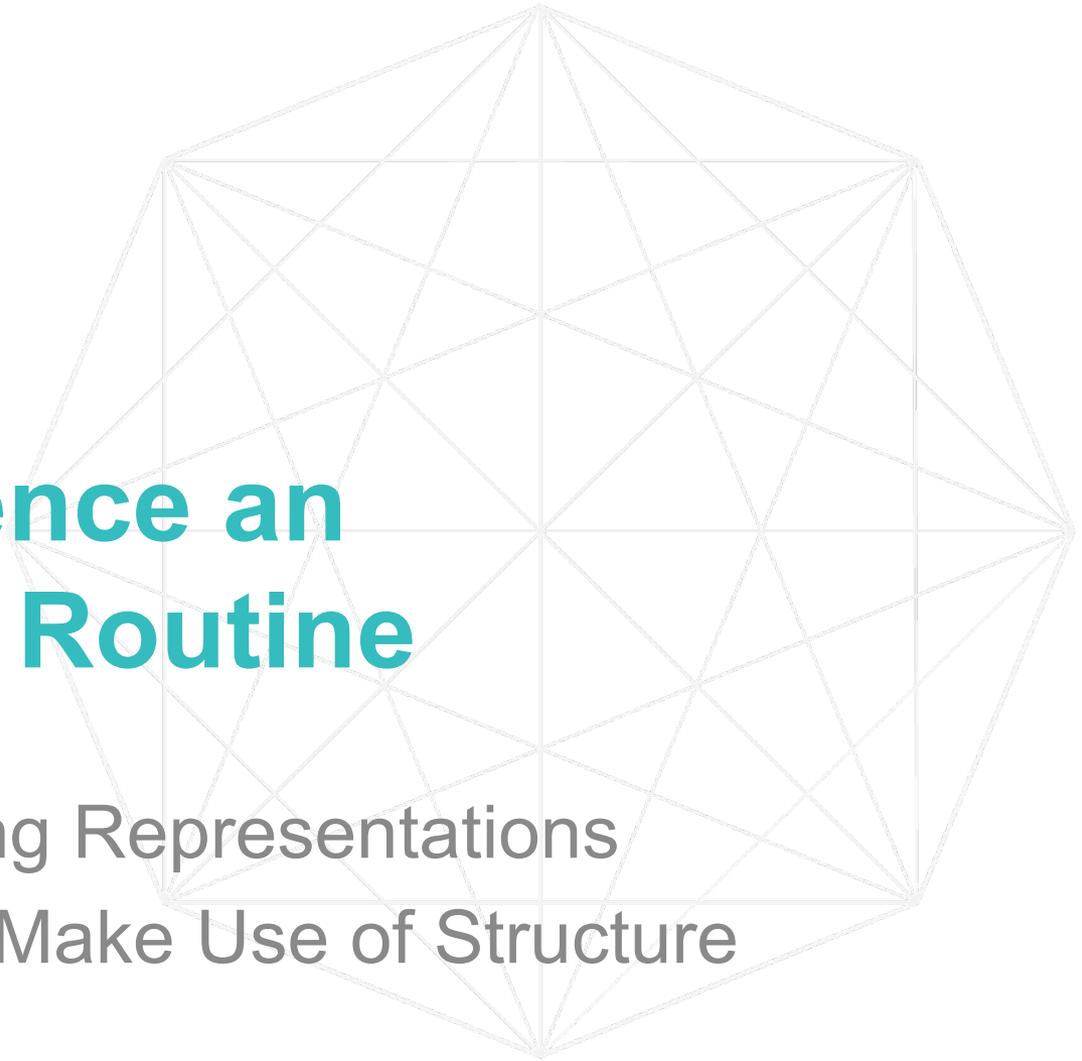
# ROUTINES FOR REASONING

Instructional routines designed  
to develop the habit of  
attending to mathematical  
structure

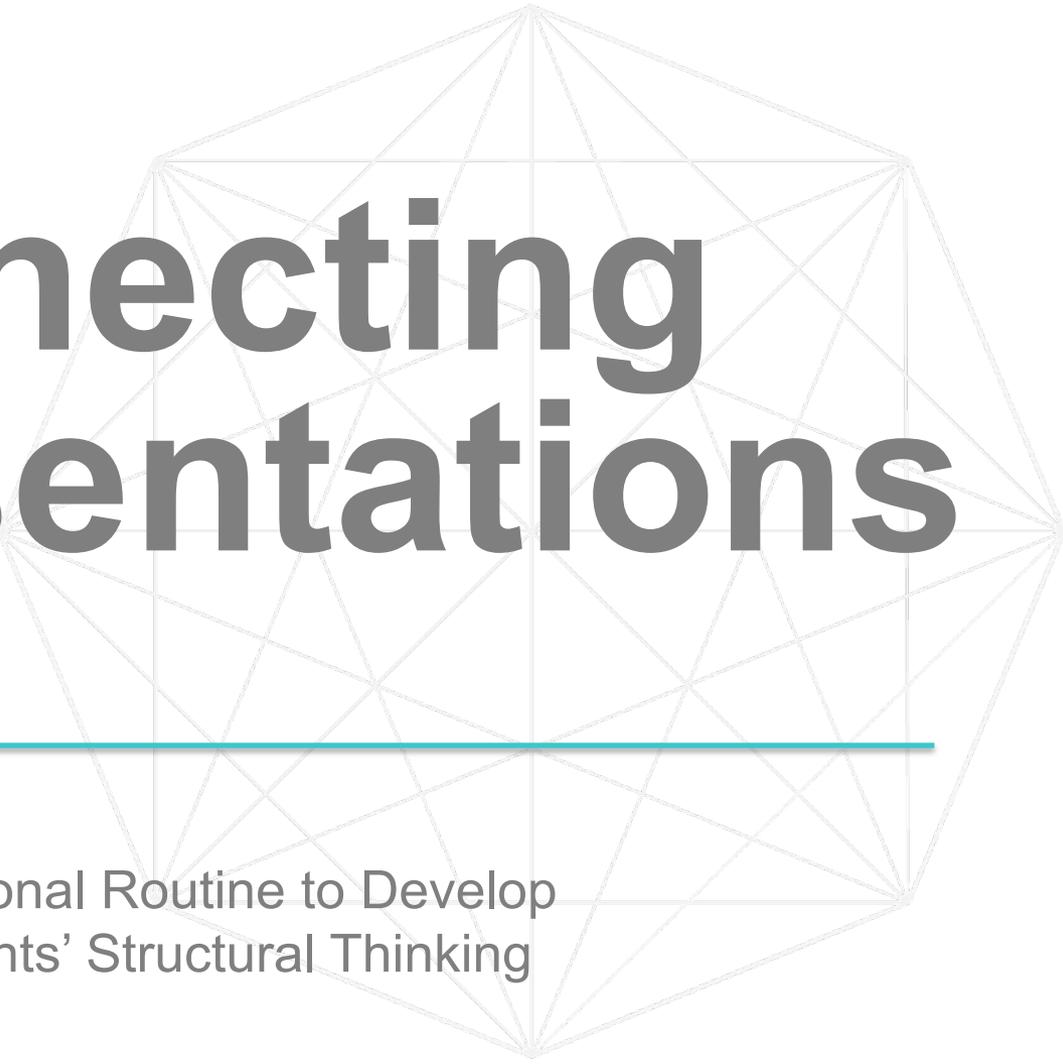


# Let's Experience an Instructional Routine

Connecting Representations  
Look for and Make Use of Structure



# Connecting Representations



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An Instructional Routine to Develop  
ALL Students' Structural Thinking



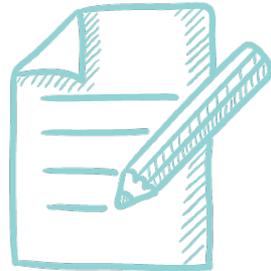
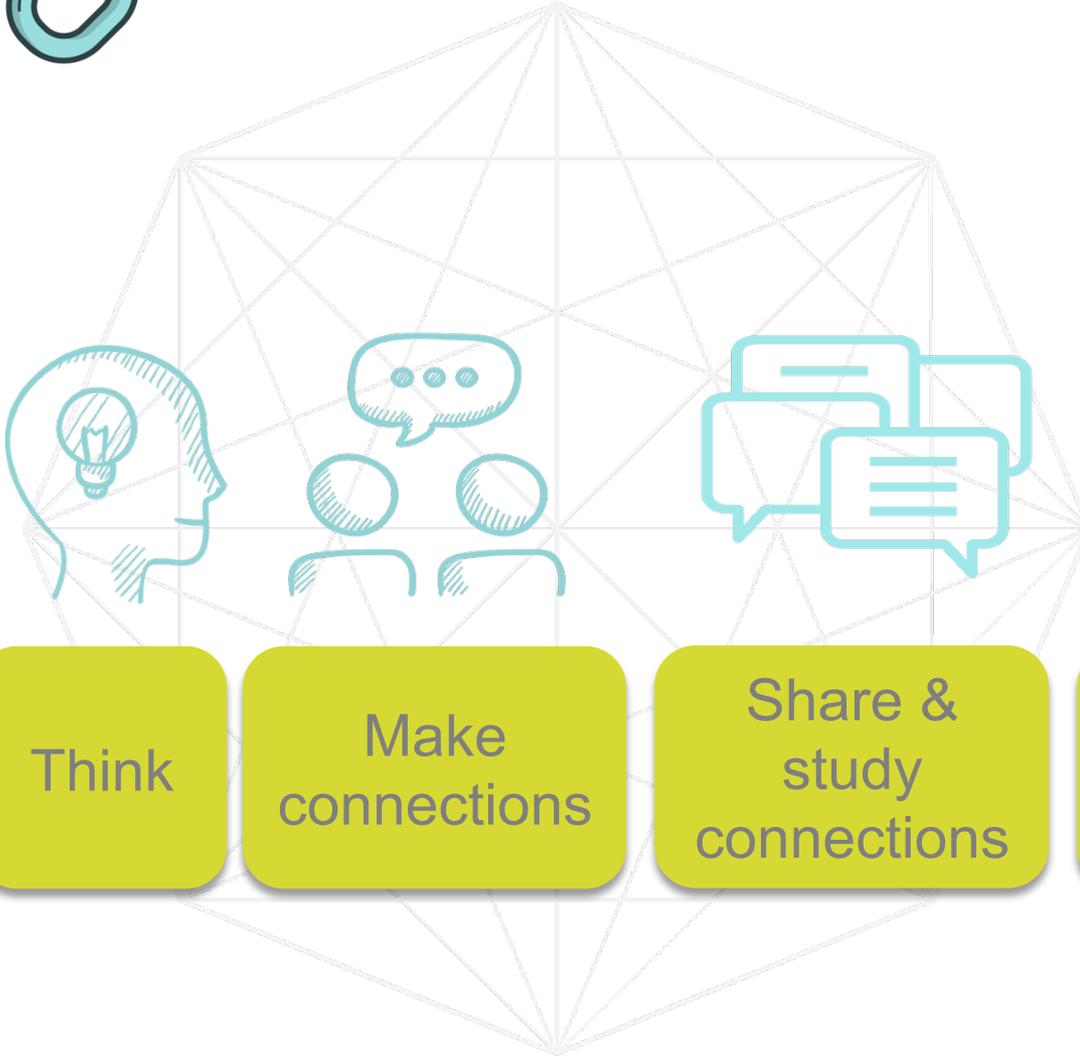
# Connecting Representations

**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

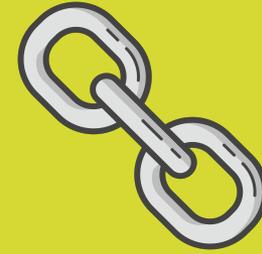
Share &  
study  
connections

Create  
representation

Reflect  
on  
learning

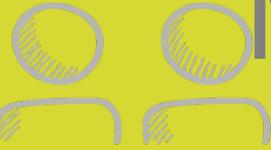


# Think

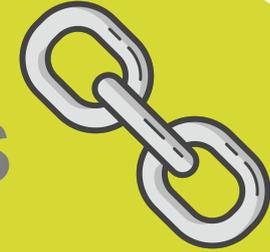


Ask yourself...

- 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



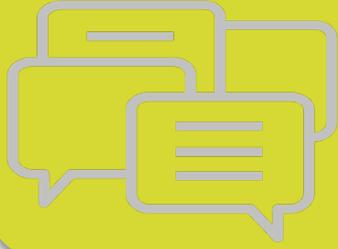
**“I saw... so I connected...”**

**“... connects to ... because...”**

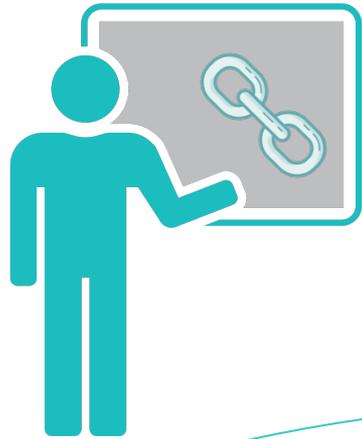
$3(10+2)$

$30+2$

$3(10+6)$  ?

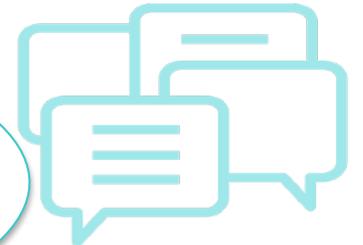


# Share & Study Connections



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

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



# Create a Representation

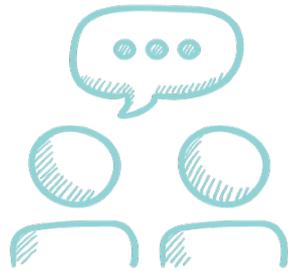


**THINK**

## Ask yourself...

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

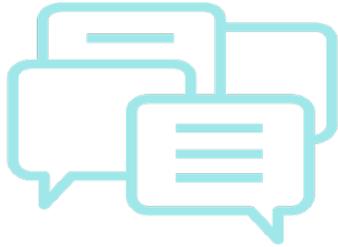
# Create a Representation



*Pair*

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

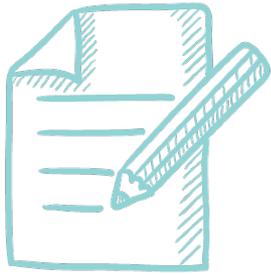
# Create a Representation



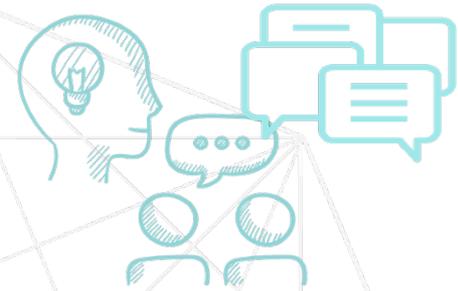
*Share*

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...

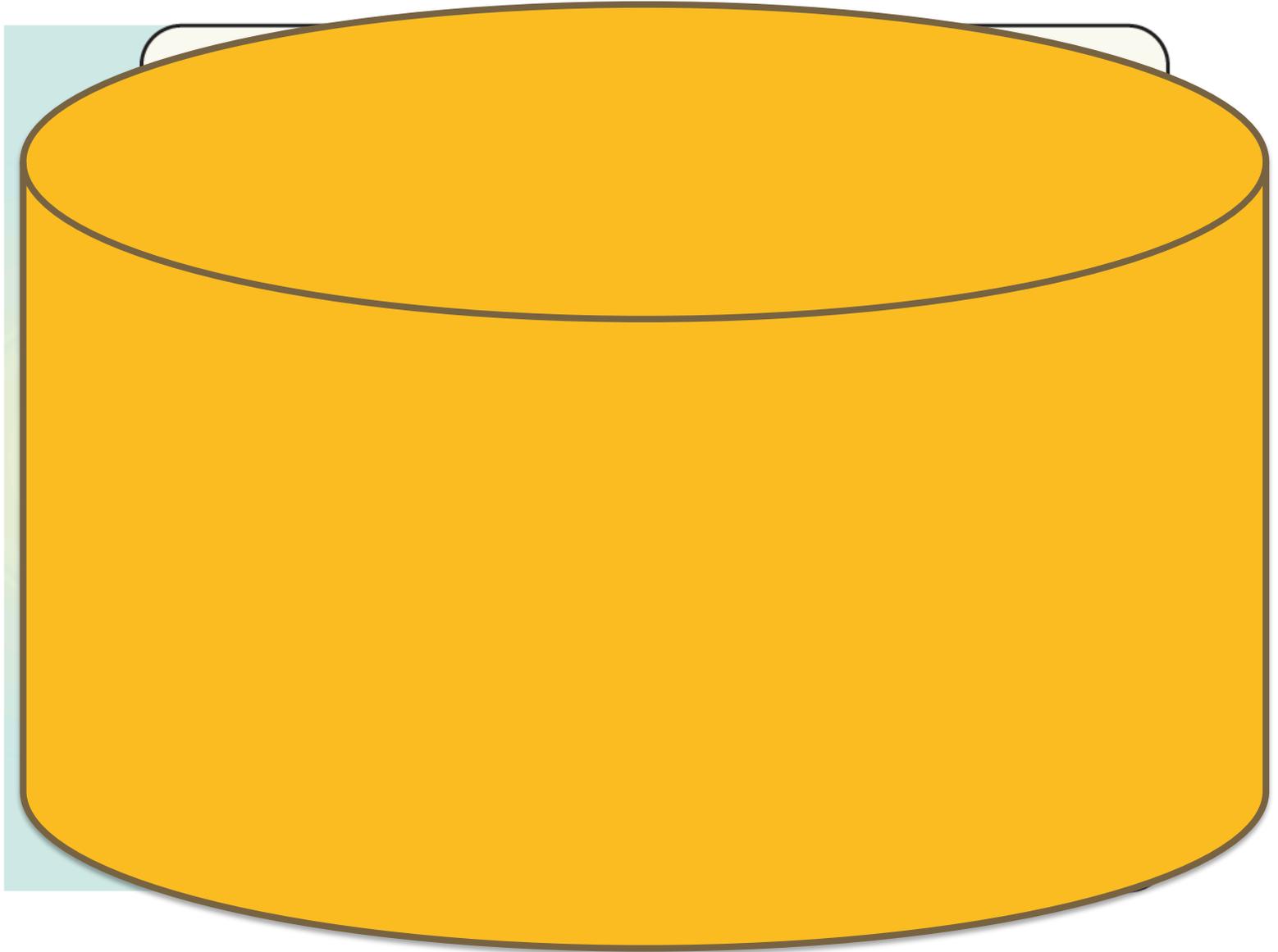
# Reflect on CR Instructional Routine



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

What questions do you have?

# Connecting Representations Container



# Connecting Representations Container

Thinking Goal: Reason Structurally

**1**

**Launch the Connecting Representations Routine:**  
Introduce thinking goal, review routine's steps

**2**

**Interpret and Connect Representations**

Individual Think Time  


Pairs



Share: Discuss and Annotate



**3**

**Create Representations**

Individual Think Time  


Pairs



**4**

**Discuss Representations**

Individual Think Time  


Pairs



Share: Discuss and Annotate



**5**

**Reflect on Your Thinking**

Individual Write Time  

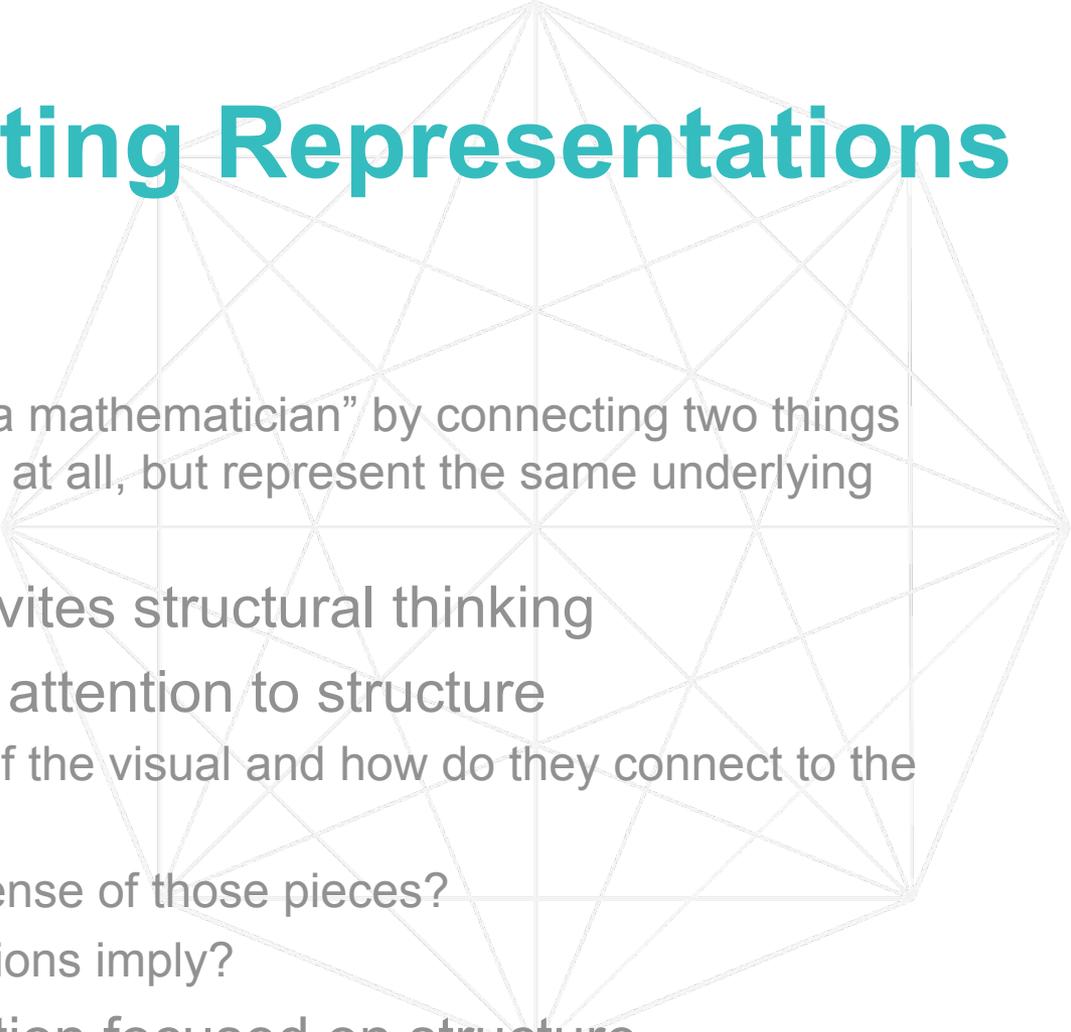

Pairs



Share and Record



# 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 \_\_\_\_\_



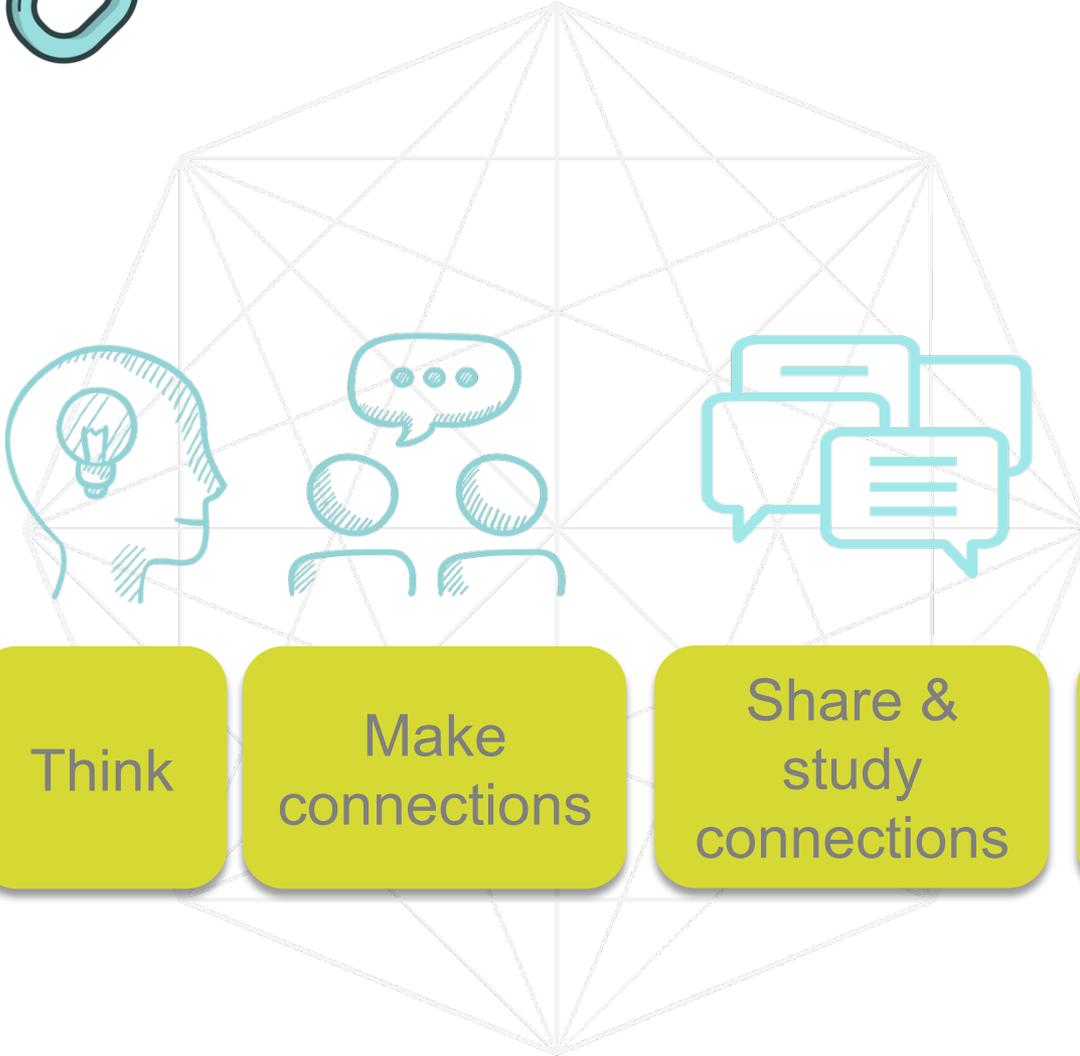
# Connecting Representations

**WHAT:** Match words (verbal descriptions) 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 chunk of the *verbal description* will help me connect to a part of the *expression*?
- What about the *expression* will help me connect to the verbal description?

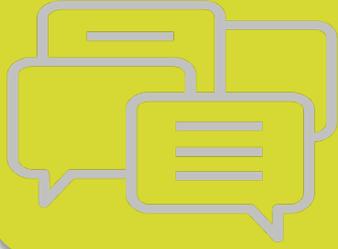


# Make Connections

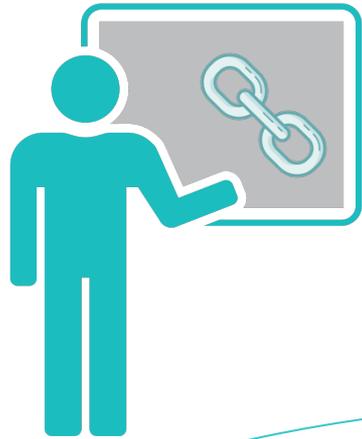


**“I saw... so I connected...”**

**“... connects to ... because...”**

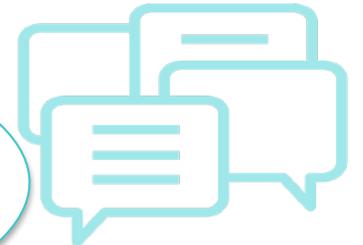


# Share & Study Connections



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We knew... so we...

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



# Create a Representation

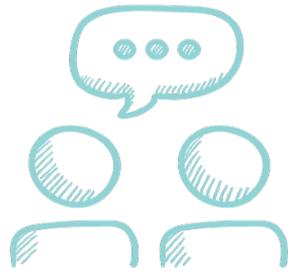


**THINK**

## Ask yourself...

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- “How can you chunk this *expression* into pieces you can describe?”

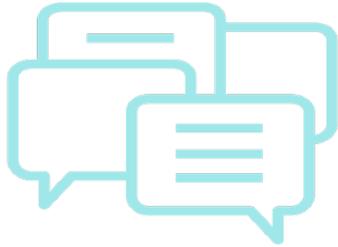
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*Pair*

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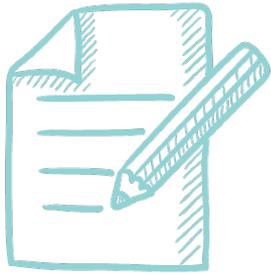
# Create a Representation



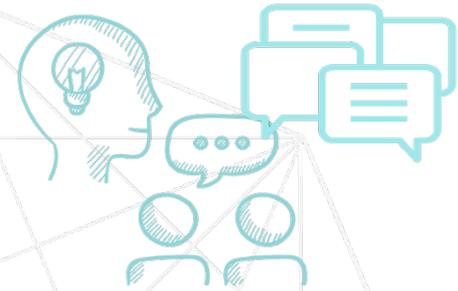
*Share*

They noticed... so they...

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



# Meta-Reflection

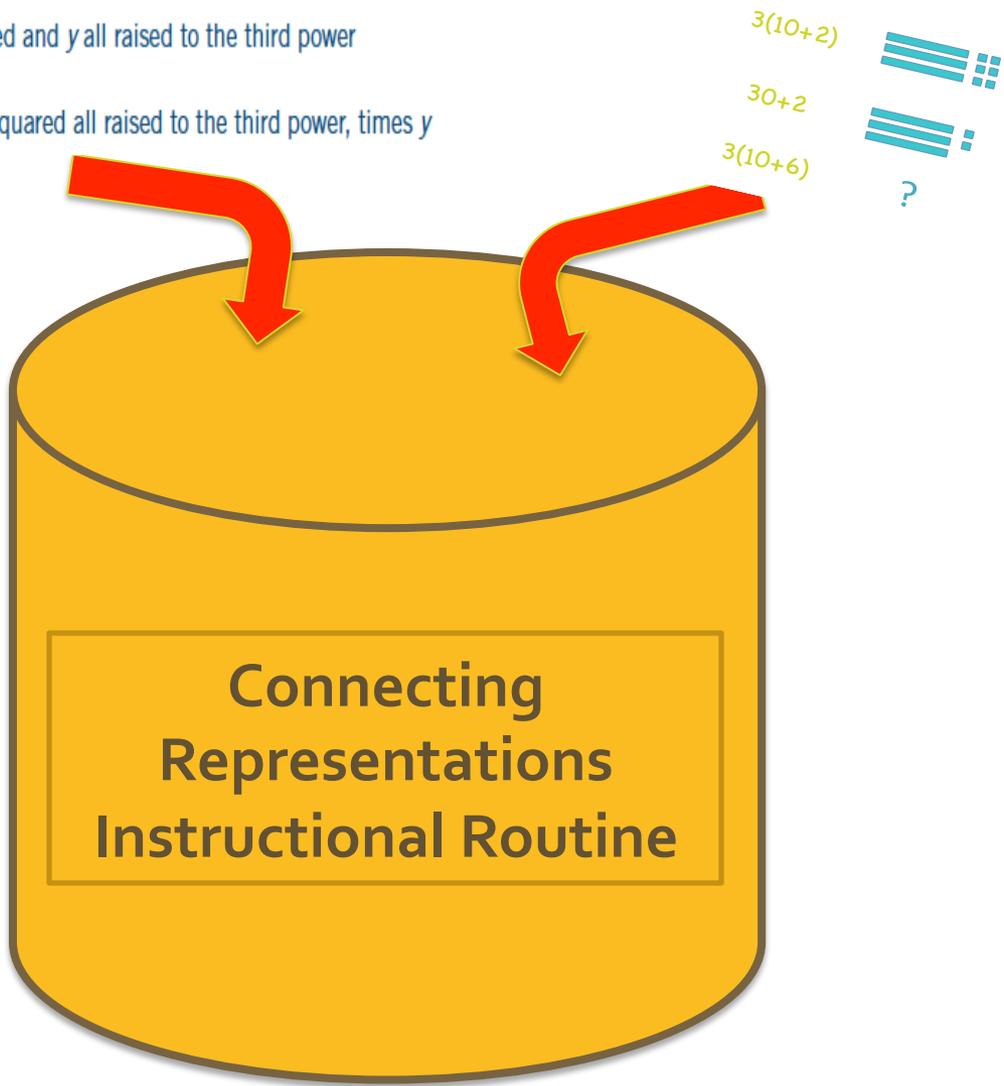


- A. When interpreting an expression, I learned to pay attention to...
- B. When connecting representations, I learned to ask myself...
- C. A new mathematical connection I made is...

$2(x^2y^2)^3$  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 Container

Thinking Goal: Reason Structurally

**1**

**Launch the Connecting Representations Routine:**  
Introduce thinking goal, review routine's steps

**2**

**Interpret and Connect Representations**

Individual Think Time  


Pairs  


Share: Discuss and Annotate  


**3**

**Create Representations**

Individual Think Time  


Pairs  


**4**

**Discuss Representations**

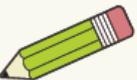
Individual Think Time  


Pairs  


Share: Discuss and Annotate  


**5**

**Reflect on Your Thinking**

Individual Write Time  


Pairs  


Share and Record  

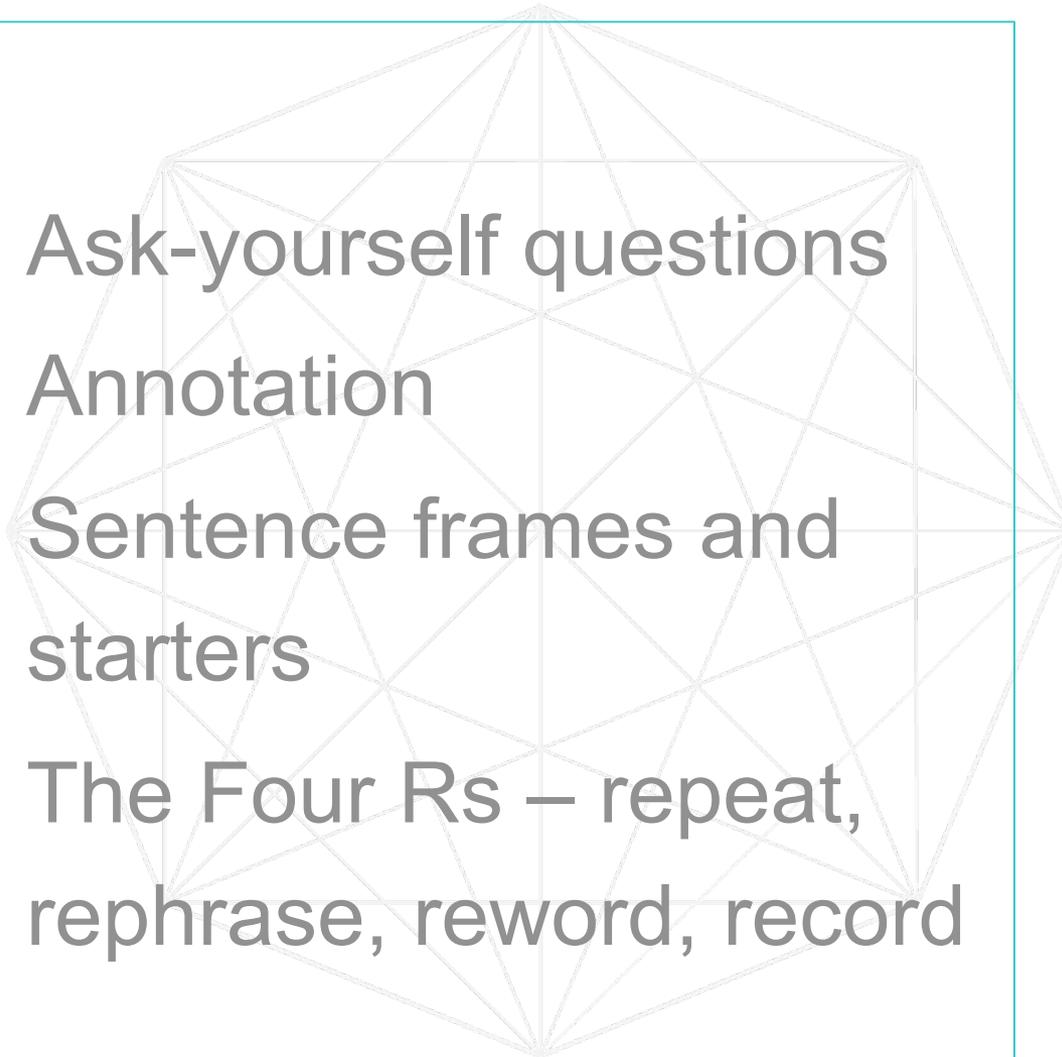

# Reflect on CR Instructional Routine



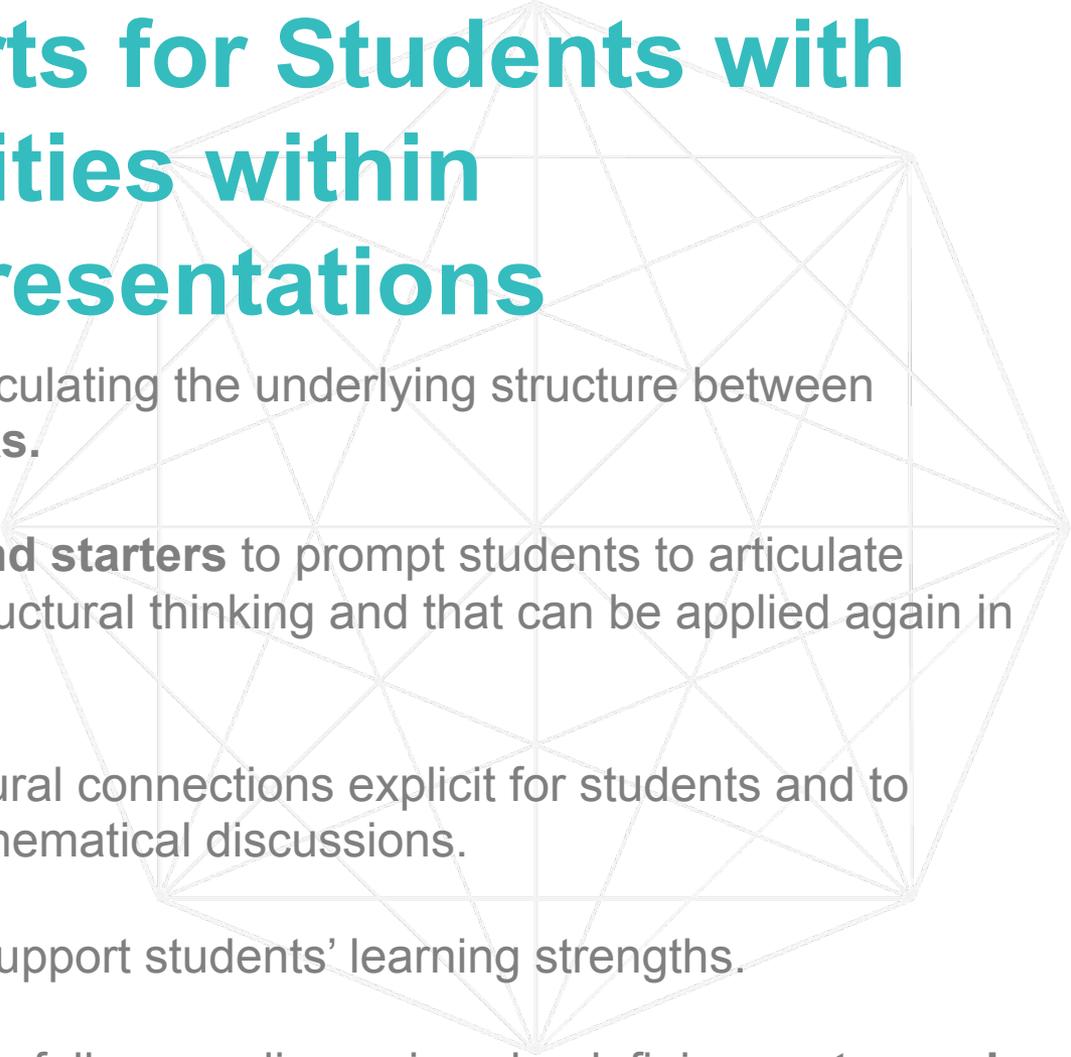
How does/can the Connecting Representations instructional routine provide access and support for SWLD to develop the math practices?

## 4 Essential Instructional Strategies

Keeping the focus on the mathematical thinking while providing access for a wide range of learners

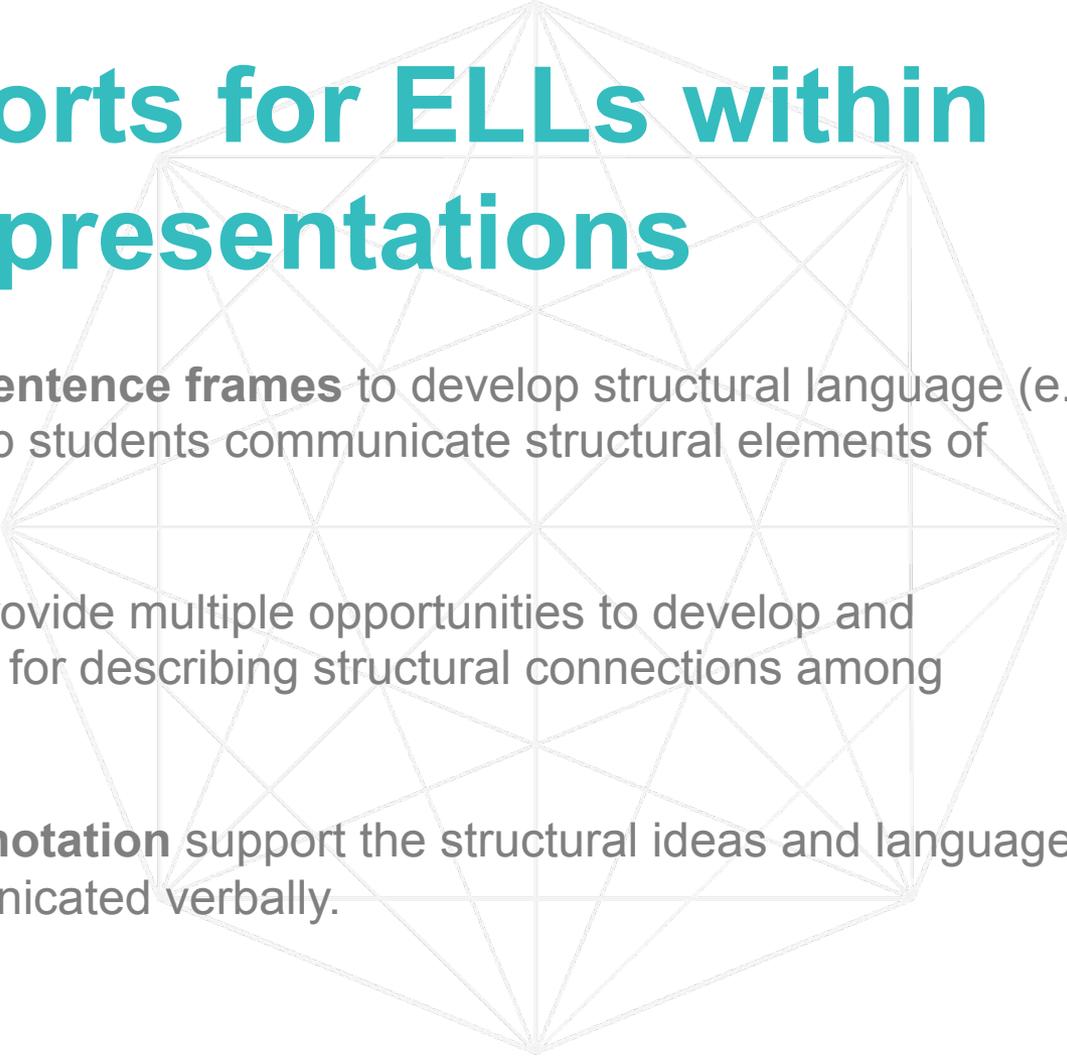
- 
- Ask-yourself questions
  - Annotation
  - Sentence frames and starters
  - The Four Rs – repeat, rephrase, reword, record

# 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**.

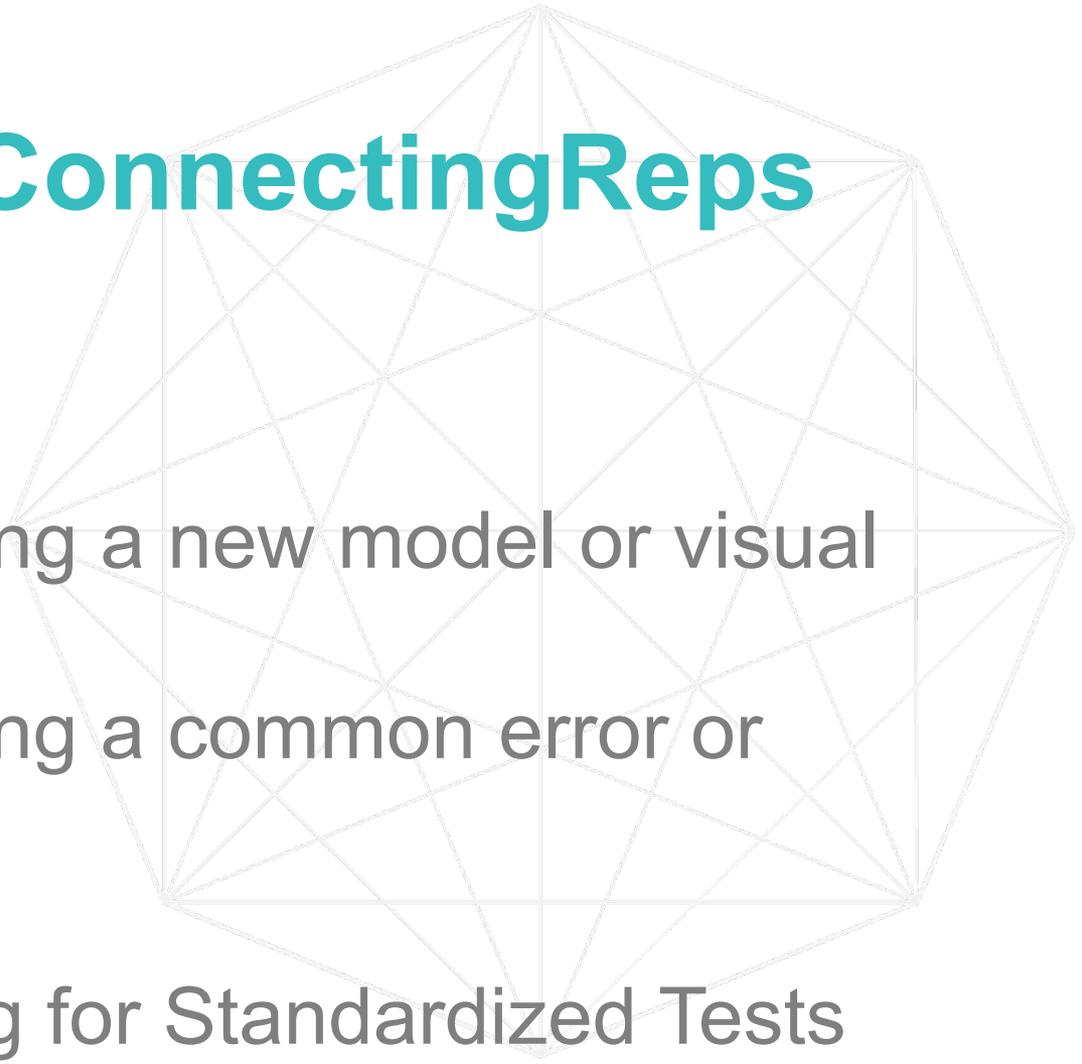
# Baked-In Supports for ELLs within Connecting Representations



- 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.

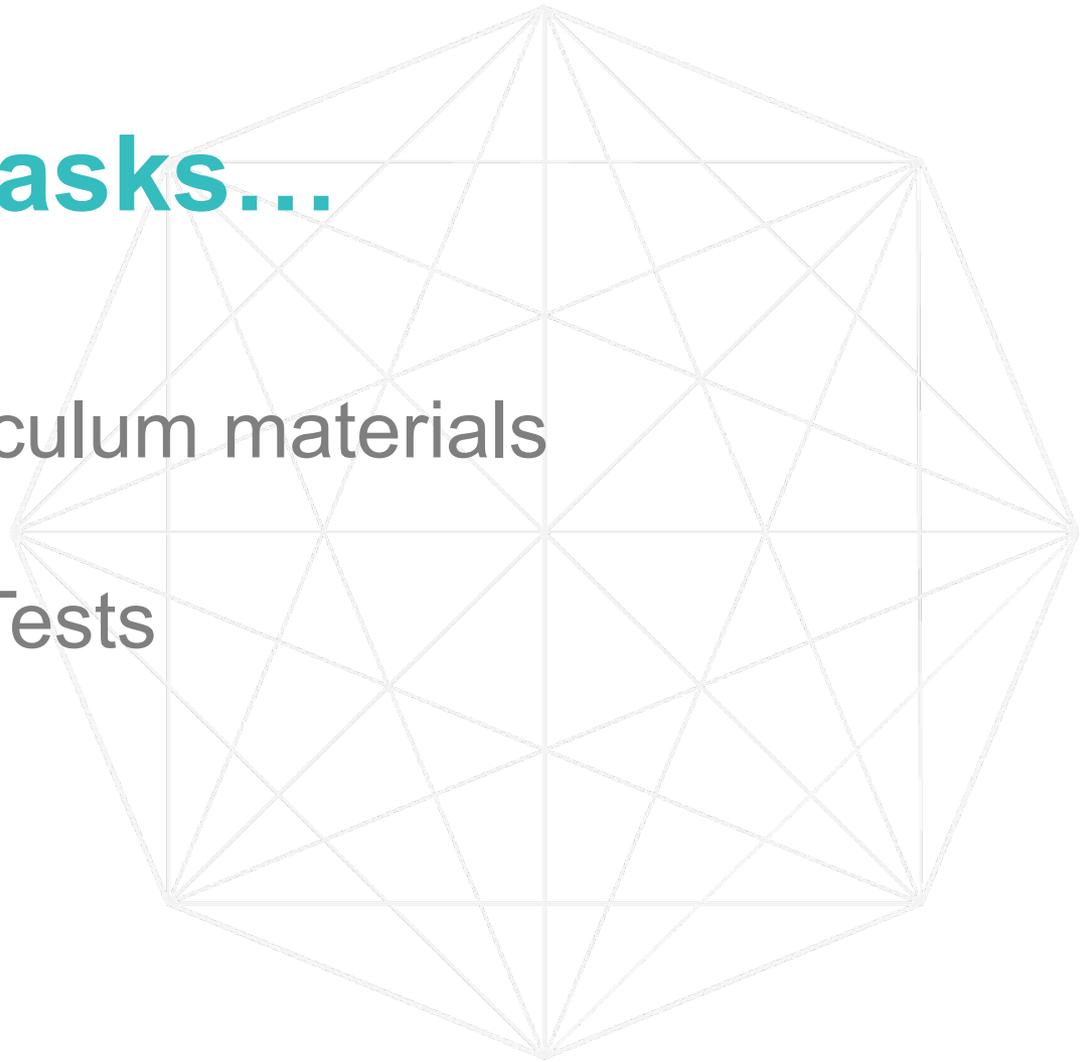
# When to use #ConnectingReps

- When introducing a new model or visual
- When addressing a common error or misconception
- When preparing for Standardized Tests



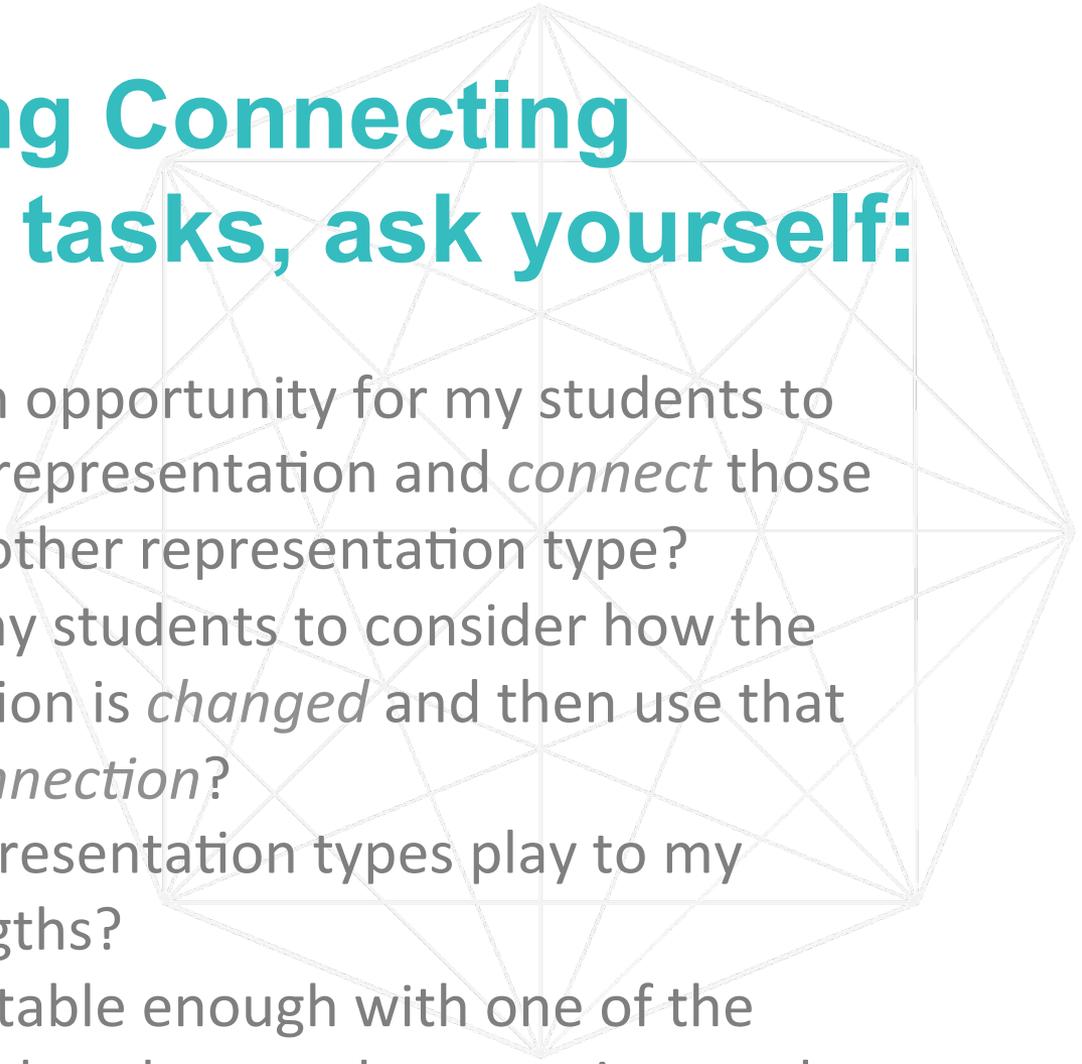
# Where to find tasks...

- Your own curriculum materials
- Standardized Tests
- Student work
- [www.fosteringmathpractices.com](http://www.fosteringmathpractices.com)



# When considering Connecting Representations tasks, ask yourself:

- Does the task provide an opportunity for my students to interpret *chunks* of one representation and *connect* those chunks to pieces of the other representation type?
- Does the task position my students to consider how the form of one representation is *changed* and then use that difference to make a *connection*?
- Does one of the two representation types play to my students' learning strengths?
- Are my students comfortable enough with one of the representation types so that they can leverage it to make sense of the other type of representation?



# Connecting Representations

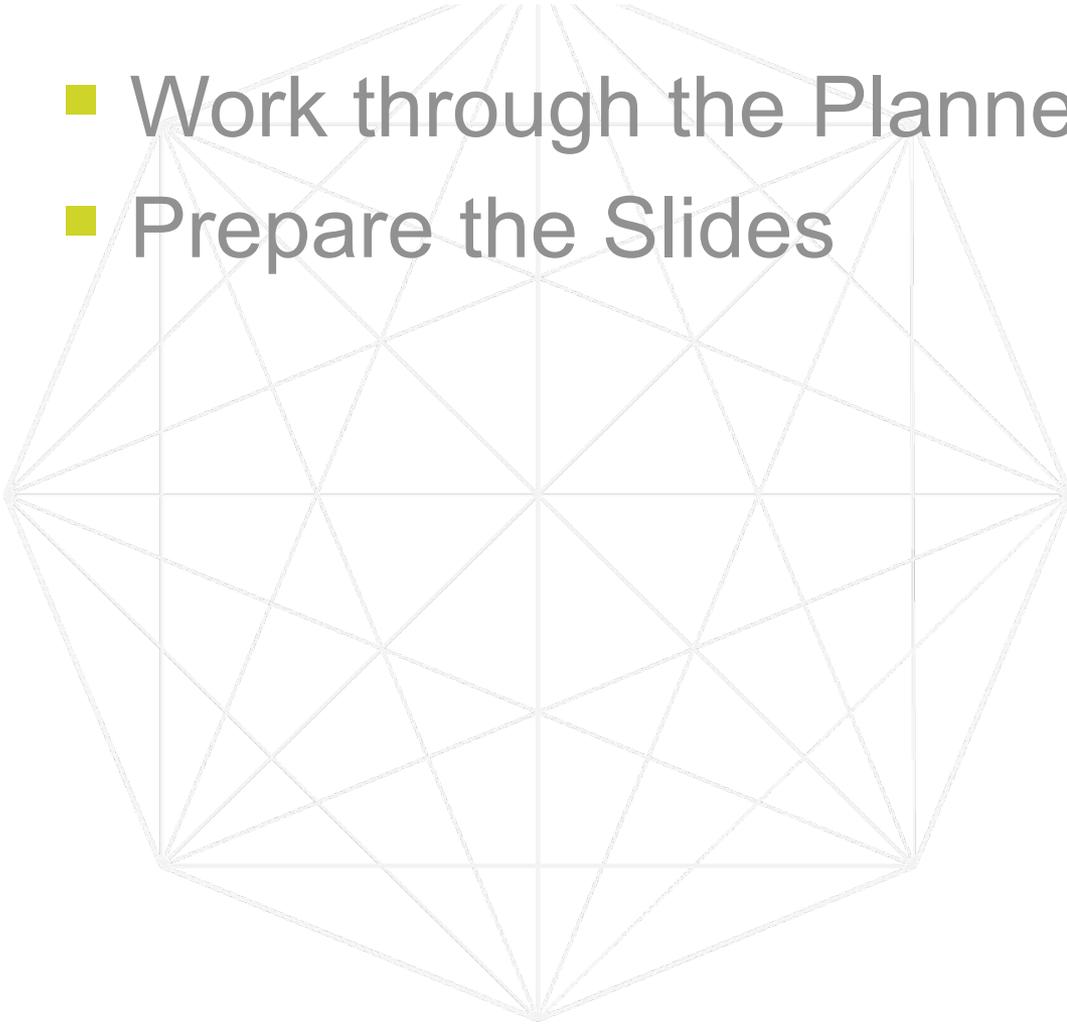
## Planning Part 1

- 
- Do the Math
  - Anticipate Connections
  - Articulate Big Ideas
  - Anticipate Annotations
  - Anticipate Reflections

# Connecting Representations

## Planning Part 2

- Work through the Planner
- Prepare the Slides



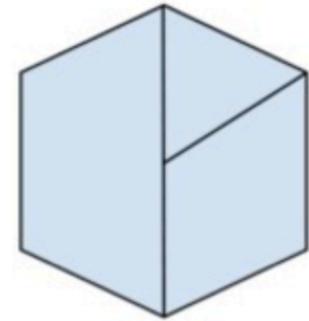
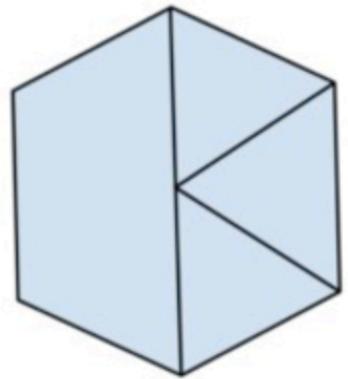
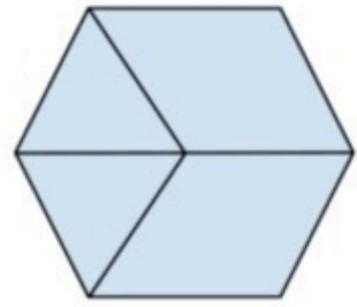
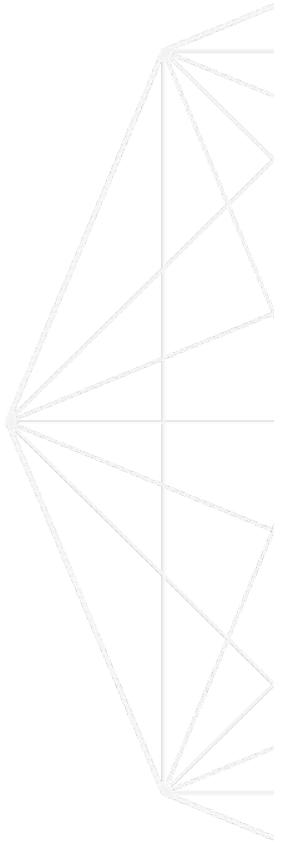
# Dropping In....

How might you annotate connections?

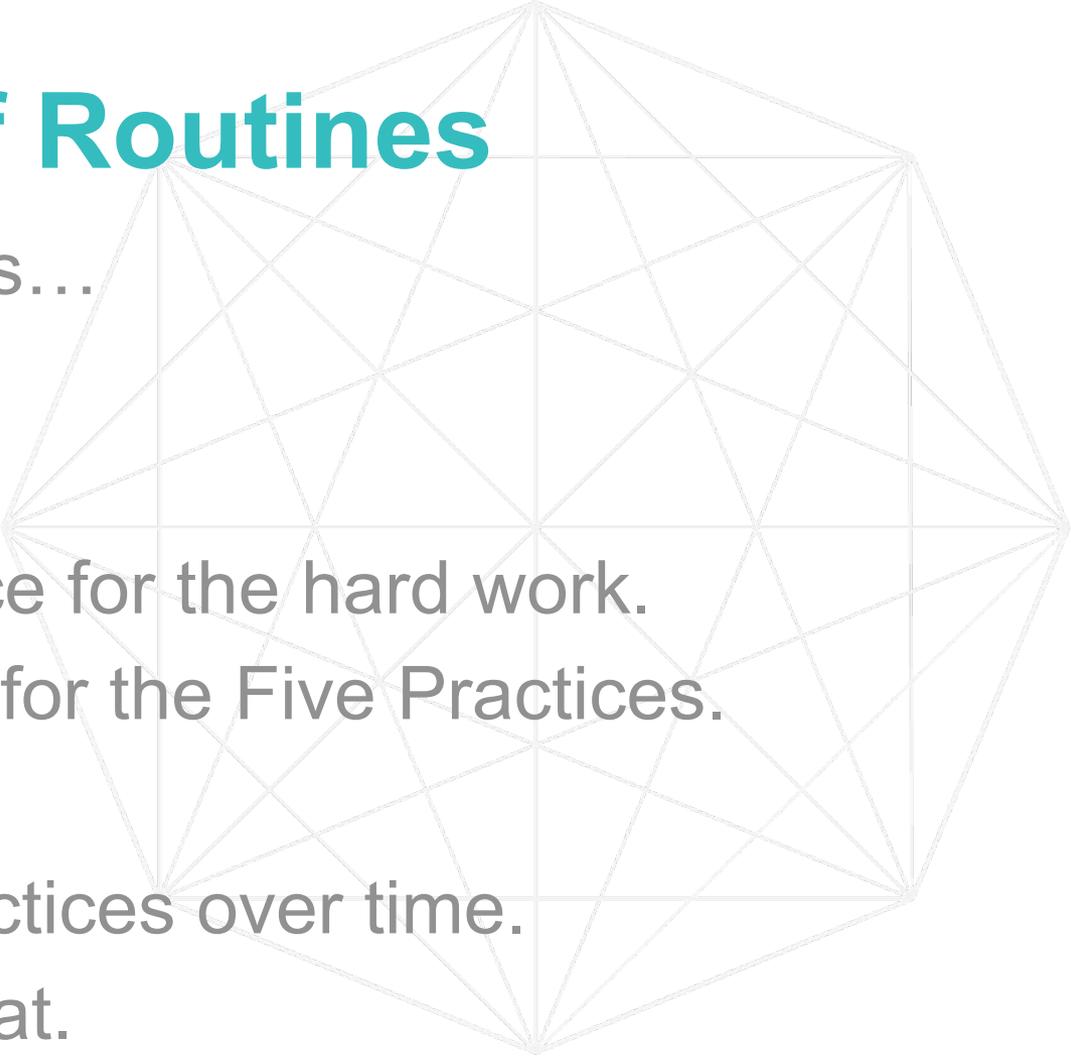


$$\frac{1}{3} + \frac{1}{6} = \frac{1}{2}$$

$$\frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{1}{2}$$



# 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....

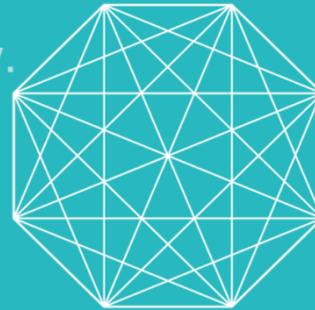
- Develop equitable practice in a classroom, school, district.

# www.fosteringmathpractices.com



## Welcome!

1. Register to join our learning community.
2. Check back often for updates.
3. Please let us know what you think.



# FOSTERING MATH PRACTICES

### We're thinking about...

Summer is a time for renewal and reflection, a time to take stock, to consider your students' long-lasting learning. And, most importantly, the ways in which you plan to foster the standards for mathematical practice in all of your students. Whichever math

### Events We Are Attending

[All](#) | [Upcoming](#) | [2016](#) | [2017](#)

TUE  
15  
AUG

THU  
17  
AUG

One By One  
Conference,

### Tweets



[#fosteringMPs](#)



# www.fosteringmathpractices.com

Free Resources (Site Registration/Login Required)

Go to Downloads

View Tasks

Classroom Planner



Connecting Representations Instructional Routes Pre-Planner

Consider the Representations:

What are the representations you will use? What are the strengths and weaknesses of each? How do they connect to the rest of the unit?

When considering the representations, ask yourself:

What are the representations you will use? What are the strengths and weaknesses of each? How do they connect to the rest of the unit?	
How will they be used? (e.g., as a model, as a tool, as a way to represent a problem?)	
How might they connect representations together?	

When considering the students, ask yourself:

What representations will provide access to students?	
What representations will...	

Classroom PPTX Template



Tasks & Discussion



# For More on Fostering Math Practices through Instructional Routines

## *Reach Out*

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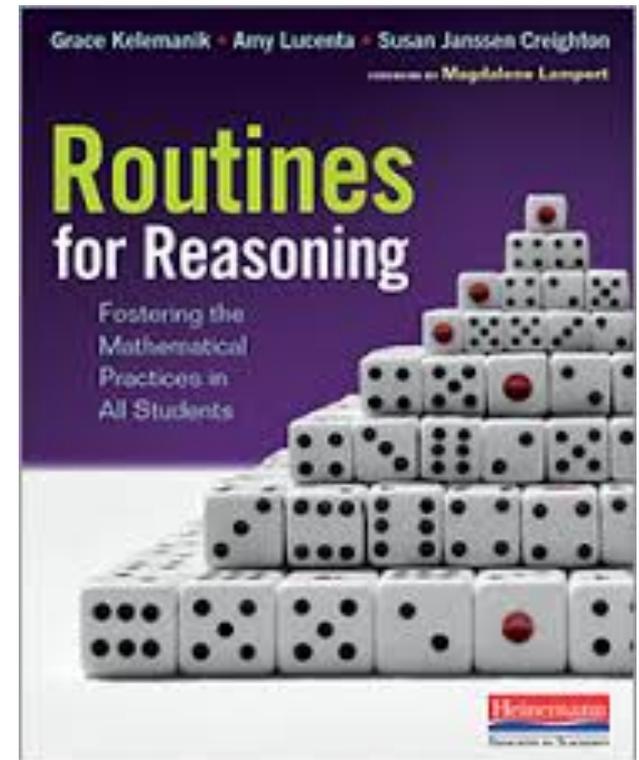
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# Please provide feedback

## OnebyOne 2017 Session Feedback

\* Required

Session Date \*

- Tuesday, August 15
- Wednesday, August 16
- Thursday, August 17

NEXT