

Connecting Representations Routine: Learn to foster structural thinking in ALL students

Amy Lucenta
Grace Kelemanik



#FosteringMPs
@AmyLucenta
@GraceKelemanik



FOSTERING
MATH
PRACTICES

www.fosteringmathpractices.com

Share...discuss...reflect..



#FosteringMPs

@AmyLucenta

@GraceKelemanik

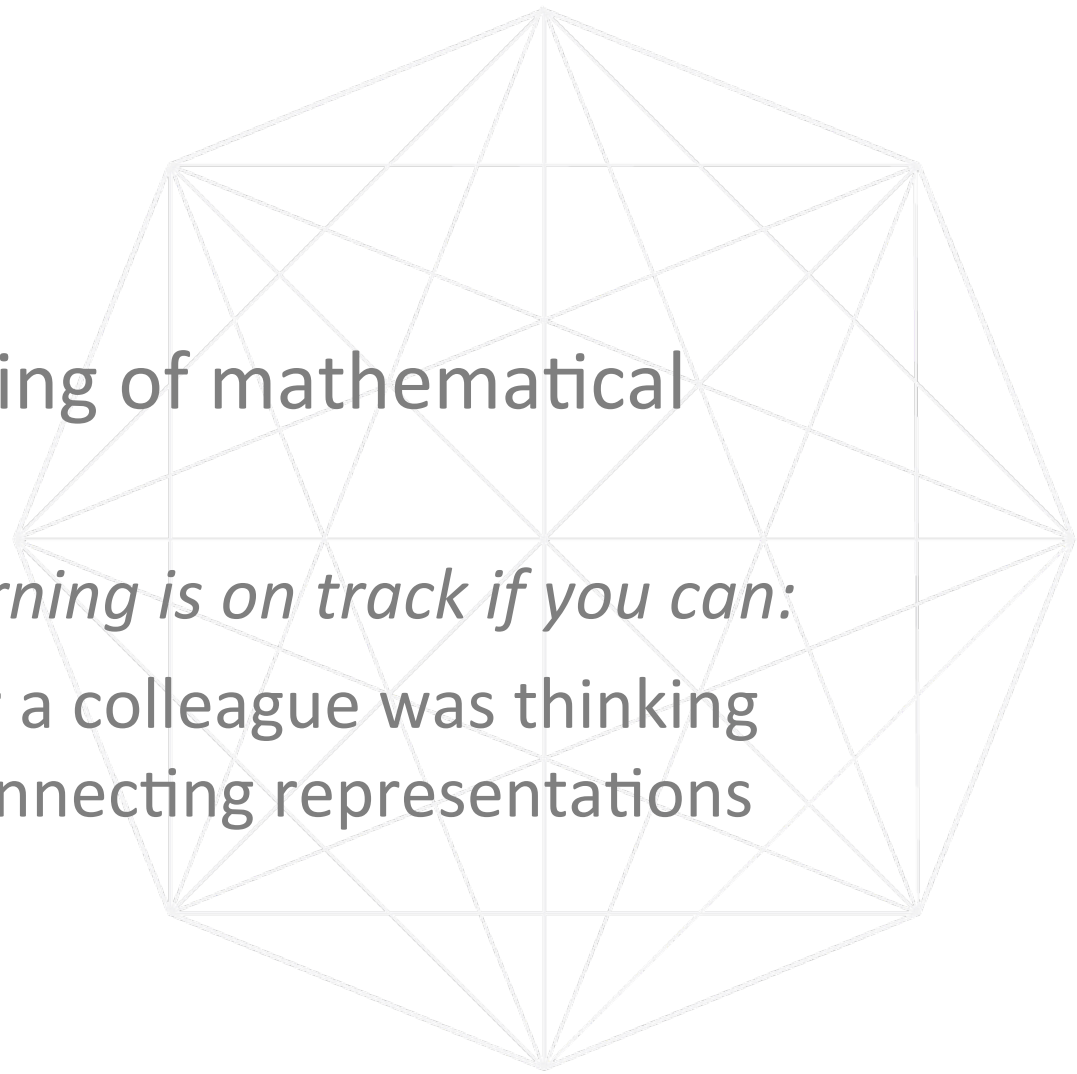
www.fosteringmathpractices.com

Goal # 1

Deepen understanding of mathematical structure.

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

- Describe how you or a colleague was thinking structurally while connecting representations

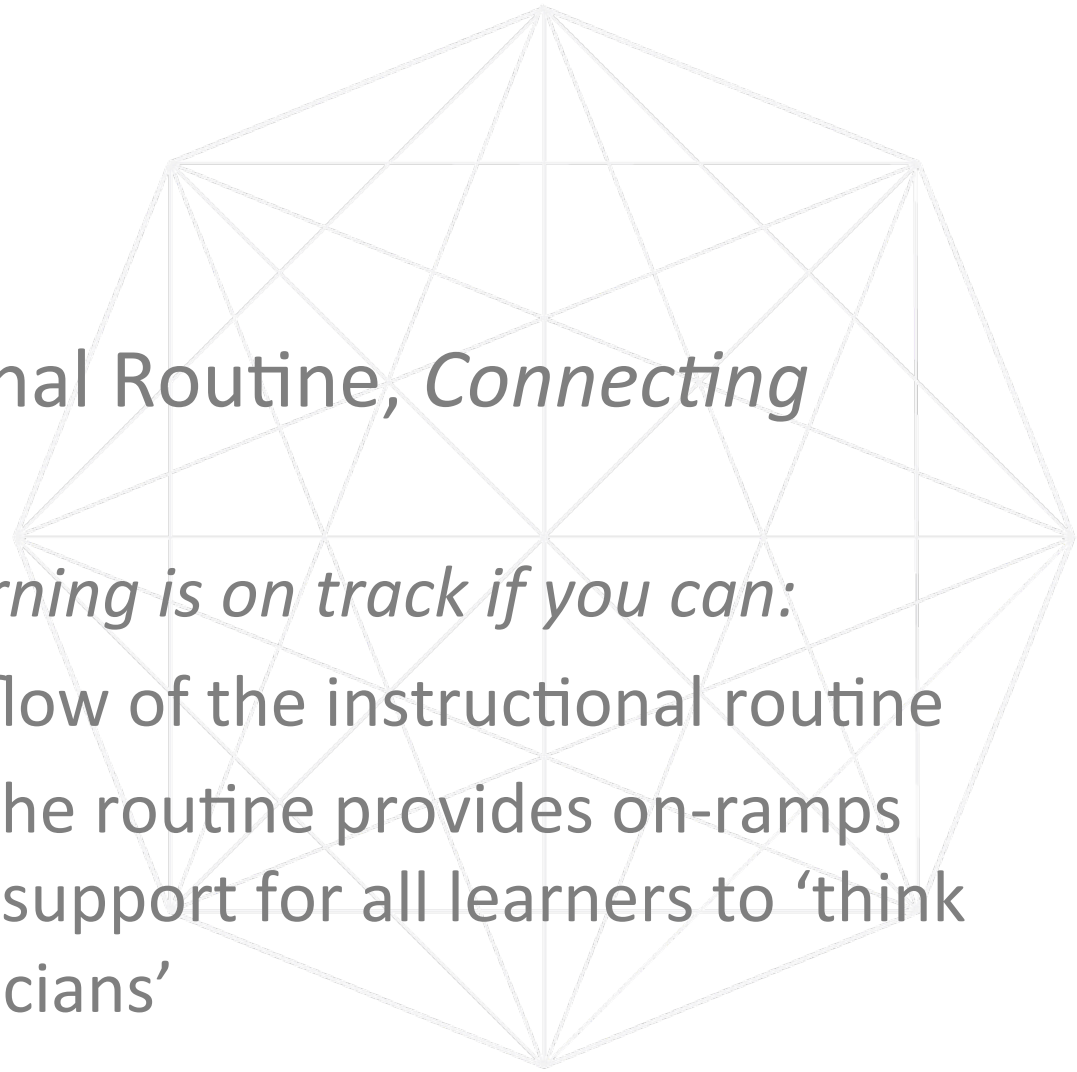


Goal # 2

Learn the Instructional Routine, *Connecting Representations*.

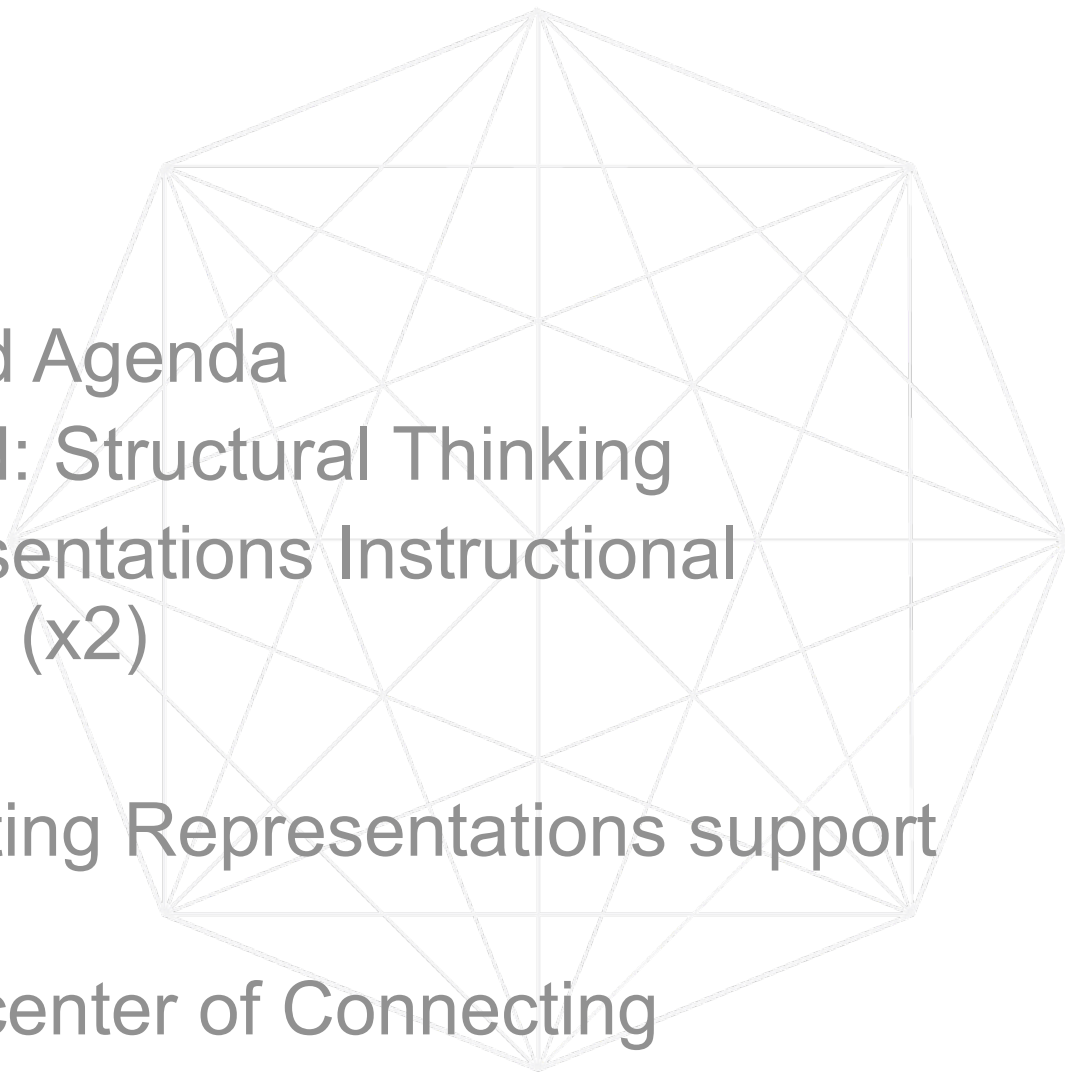
You will know your learning is on track if you can:

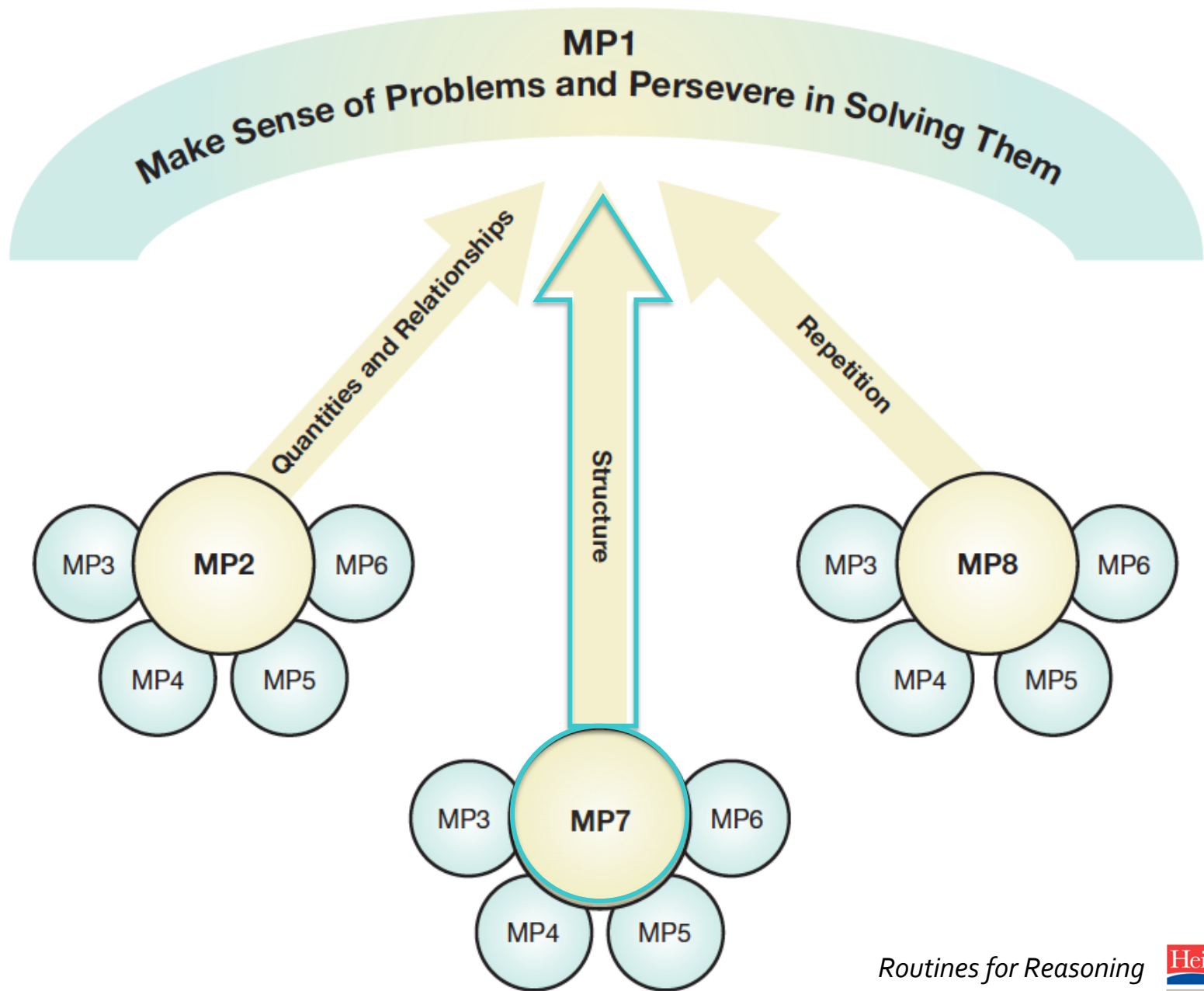
- Articulate the flow of the instructional routine
- Describe how the routine provides on-ramps and continued support for all learners to ‘think like mathematicians’



Agenda

- Opening Goals and Agenda
- A bit of background: Structural Thinking
- Connecting Representations Instructional Routine Deep Dive (x2)
- How does Connecting Representations support ALL learners?
- Tasks to sit at the center of Connecting Representations
- Resources and Questions





Structural Thinking (MP7)

Attend to...

Organization
and
Properties of
Number and Space

Ask Yourself...

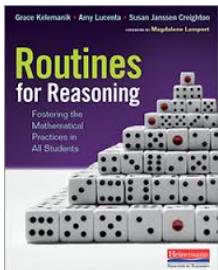
- How can I *chunk* this to make sense of it?
- How can I *change* the form to make it easier to work with?
- Can I *connect* this to something else I know?
- How can I use properties to uncover structure?

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



Connecting Representations



1

Launch Routine



THINKING GOAL
Reasoning structurally

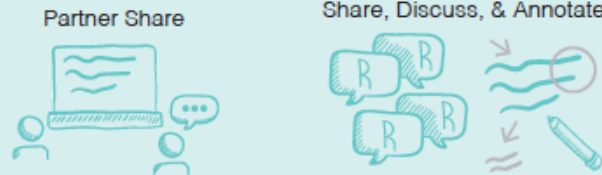
2

Make Connections



3

Share and Study Connections



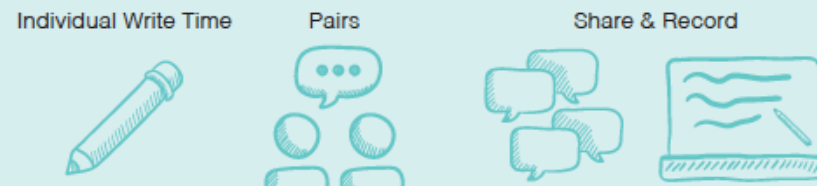
4

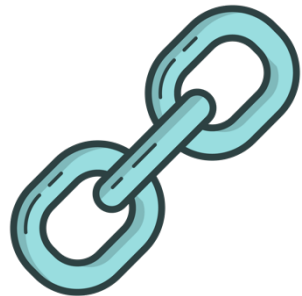
Create Representations



5

Reflect on Your Thinking





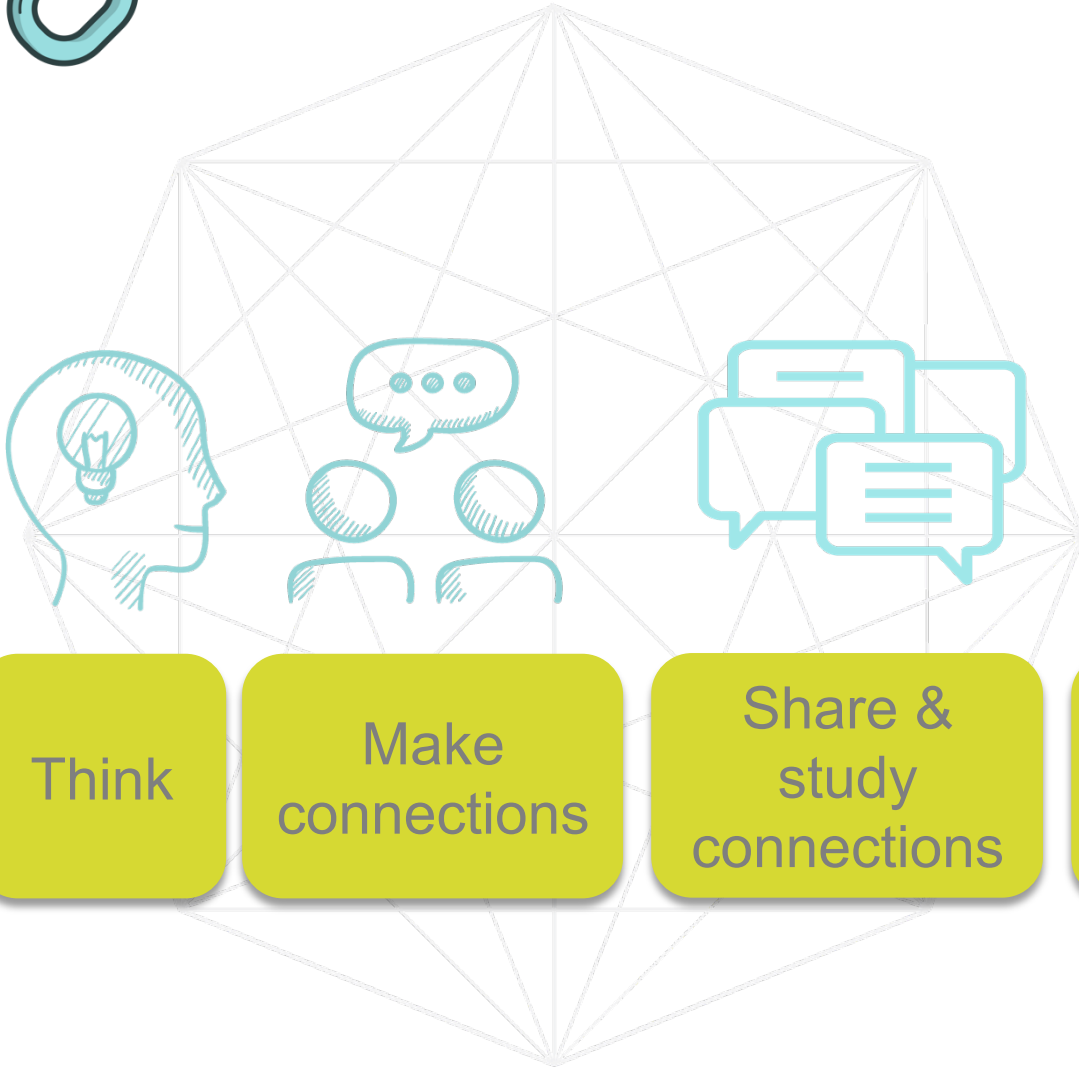
Connecting Representations

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

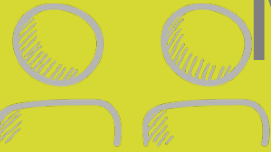
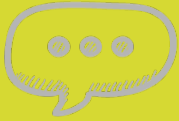


Think



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*?

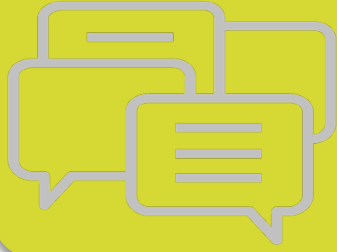


Make Connections

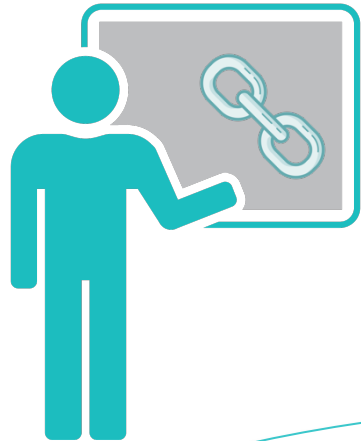


“I saw... so I connected...”

“... connects to ... because...”



Share & Study Connections



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

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



Create a Representation

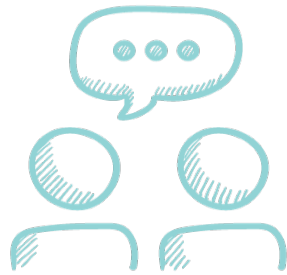


THINK

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

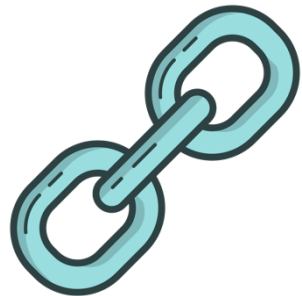


- A.** When interpreting an *expression / visual*, I learned to pay attention to...
- B.** When connecting representations, I learned to ask myself...
- C.** A new mathematical connection I made was...

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 _____



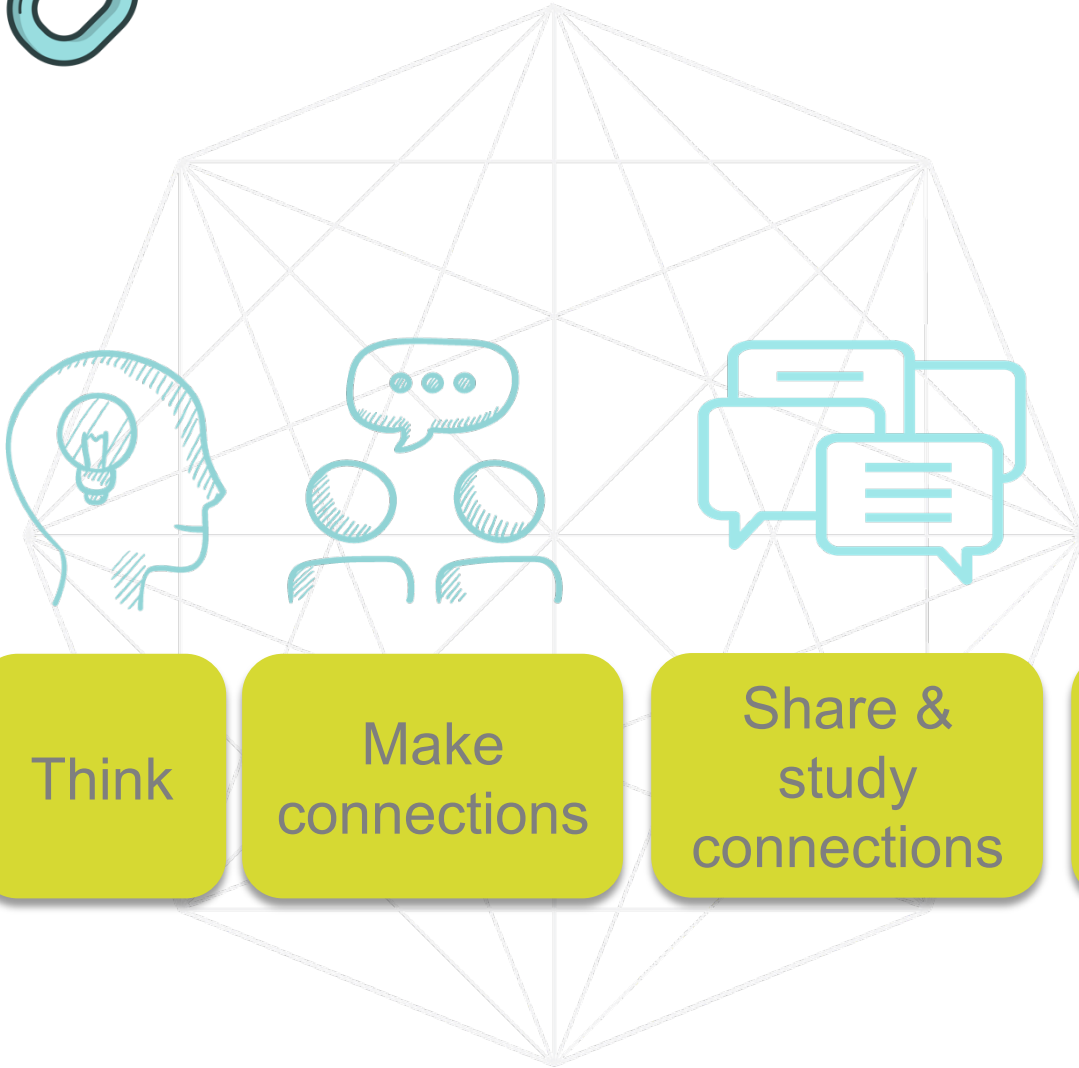
Connecting Representations

WHAT: Match graphs to words 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 *graph* will help me connect to the *words* that describe it?
- What about the *words* will help me connect to the *graph*?

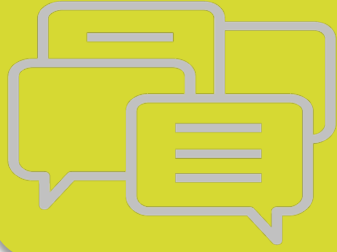


Make Connections

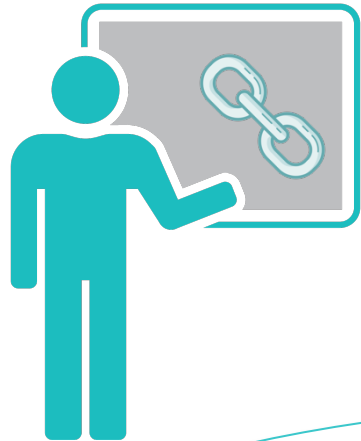


“I saw... so I connected...”

“... connects to ... because...”

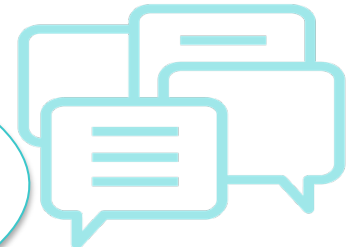


Share & Study Connections



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

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



Create a Representation

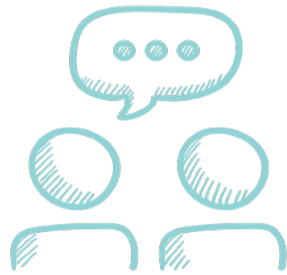


THINK

Ask yourself...

- “What do you notice about this *segment of the graph*?”
- “How can you connect this *segment of the graph* to what you already know about the situation?”

Create a Representation



Pair

- Share your interpretations of the *graph*.
- Together write a matching *verbal description*.

Create a Representation



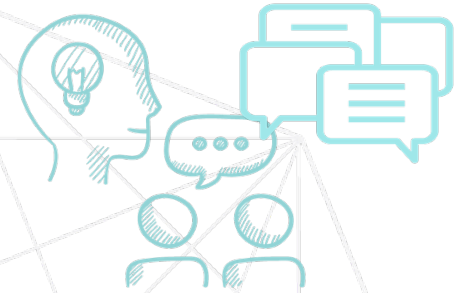
Share

They noticed... so they...

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



Meta-Reflection





- A. When interpreting a graph, 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




Connecting Representations

1 Launch Routine  **THINKING GOAL**
Reasoning structurally

2 Make Connections  

3 Share and Study Connections  

4 Create Representations   

5 Reflect on Your Thinking   



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

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

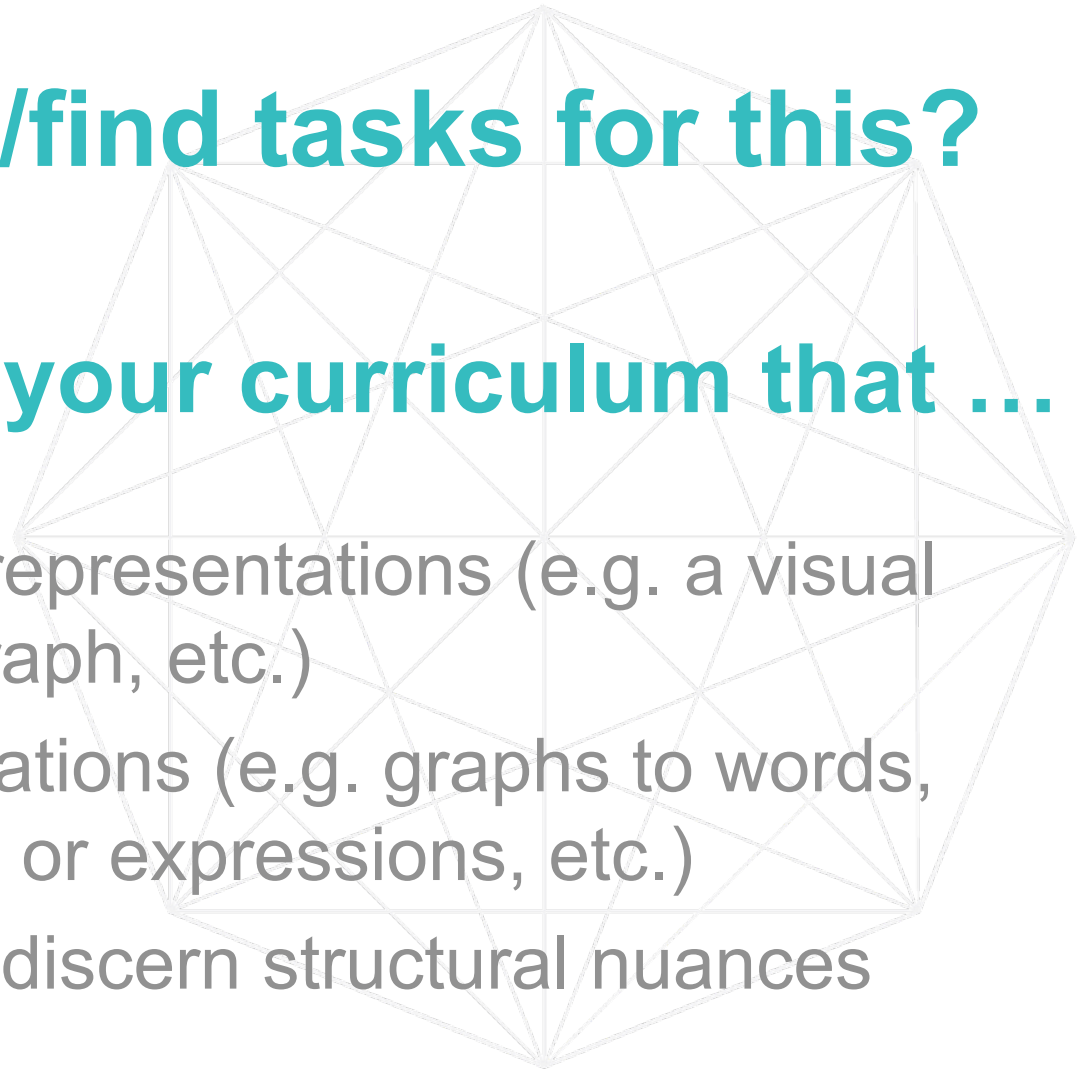


- Use **sentence starters and sentence frames** to develop structural language (e.g. chunk, change, connect) and help students communicate structural elements of representations.
- Make use of the **Four Rs** to provide multiple opportunities to develop and refine academic language crucial for describing structural connections among representations.
- Ensure that **gestures and annotation** support the structural ideas and language and thinking that is being communicated verbally.

How do I create/find tasks for this?

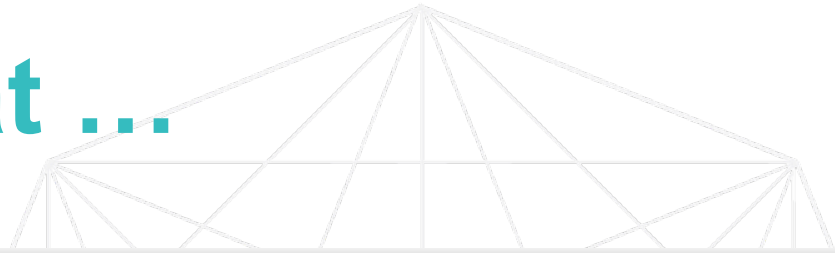
Look for tasks in your curriculum that ...

- Offer two or more representations (e.g. a visual model, diagram, graph, etc.)
- Connect representations (e.g. graphs to words, visuals to numbers or expressions, etc.)
- Cause students to discern structural nuances



Look for tasks that ...

- Offer 2 or more representations
- Connect the visuals expressions
- Cause students to discern structural nuances

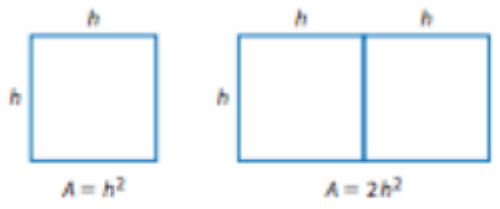


Is $5h + 2h^2$ equivalent to $7h$? Explain.

Picture It Imagine line segments that are h , $5h$, and $7h$ units long.



Imagine rectangles that are h^2 and $2h^2$ square units in area.



Model It Use math tiles to model $5h$, $2h^2$, and $7h$.



Look for tasks that ...

- Offer 2 or more representations
- Connect the visuals expressions
- Cause students to discern structural nuances

▶ **Connect It** Now solve the problem.

19 Look at *Picture It*. If you combine the line that is $5h$ units long and the rectangle that is $2h^2$ units in area, do you get a figure that looks like the line that is $7h$ units long? No

20 Look at *Model It*. If you put the tiles representing $5h$ together with the tiles representing $2h^2$, do you get a set of tiles that represents $7h$? No

21 Richard says that $5h$ and $2h^2$ are like terms because they both have the variable h . Is Richard correct? Explain. No. For terms to be like terms the variable factors must be exactly the same. The variable h in the term $2h^2$ is raised to the second power. The variable h in the term $5h$ is not.

22 Is $5h + 2h^2 = 7h$ a true statement? Substitute a value other than 0 or 1 for h and evaluate $5h + 2h^2$ and $7h$ to support your answer. No. For example, let $h = 3$:

$$\underline{5h + 2h^2 = 5(3) + 2(3)^2 = 15 + 2(9) = 15 + 18 = 33, \text{ but } 7h = 7(3) = 21.}$$

$$\underline{\text{Because } 33 \neq 21, 5h + 2h^2 \neq 7h}$$

23 Apply the distributive property to write an expression that is equivalent to $5h + 2h^2$. Show your work.

$$\underline{5h + 2h^2 = (5 \cdot h) + (2 \cdot h \cdot h)}$$

$$\underline{5h + 2h^2 = h(5 + 2h)}$$

▶ **Try It** Use what you just learned to solve these problems. Show your work on a separate sheet of paper.

24 Are $3x + 6 + x$ and $2(2x + 3)$ equivalent expressions? Use substitution to check your answer.

Yes. Student should substitute a value for x .

25 Are $8(w + 6)$ and $5 + 8w + 1$ equivalent expressions? Use substitution to check your answer.

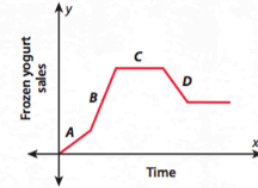
No. Student should substitute a value for w .

Look for tasks that ...

- Offer 2 or more representations
- Connect graphs to words
- Cause students to discern structural nuances

▶ **Connect It** Now you will solve a problem similar to the one on the previous page.

The graph shows daily sales of frozen yogurt at a new store during a six-month period starting on opening day in April. Describe what is happening in terms of this situation for each section of the graph.



2 Describe and interpret section A.

Possible answer: The graph starts at 0 and increases gradually. The store has just opened and sales are increasing.

3 Describe and interpret section B. **Possible answer:** It is a steep increase. Summer is starting, so more people are eating frozen yogurt.

4 Describe and interpret section C. **Possible answer:** This section is flat. Sales are consistent during the summer.

5 Describe and interpret section D. **Possible answer:** This part shows a decrease. Sales are decreasing as colder weather starts.

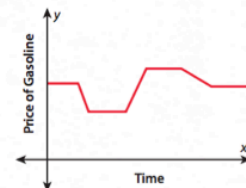
6 Use your answers to problems 2–5 to summarize what the graph shows. **Possible answer:** Sales increase gradually. As the weather warms, sales increase. Sales stay about the same for the summer, decrease with colder weather, then flatten out.

▶ **Try It** Use what you just learned about qualitative graphs to solve this problem. Show your work on a separate sheet of paper.

7 Summarize the graph showing gasoline prices.

Possible answer: The price remained the same for a while, then decreased and stayed steady for

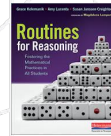
some time. After a greater increase, prices rose to the highest of the period, remained constant, then gradually dropped and steadied to about the same price as the starting price.



Where can I find more about...

■ Instructional Routines?

- Routines for Reasoning
- TEDD.org
- Fosteringmathpractices.com
- Ready Math and other curricula



■ Tasks for Connecting Representations

- Fosteringmathpractices.com
- #ConnectingReps
- YOUR OWN CURRICULUM



Avenues of Thinking

Special Populations

Routines for Reasoning ▾

Related Resources

Free Resources (Site Registration/Login Required)

[Go to Downloads](#)

[View Tasks](#)

Classroom Planner



Classroom PPTX Template



Tasks & Discussion



More about Connecting Representations and Other Instructional Routines

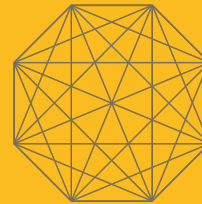
Reach Out

AmyLucenta@gmail.com

GraceKelemanik@gmail.com

Log On

www.fosteringmathpractices.com



**FOSTERING
MATH
PRACTICES**

Join the Conversation

#ConnectingReps #fosteringMPs



Get the Book

www.heinemann.com

