

Sense-Making Routines

Notice & Wonder™

Students are presented with an image or situation and are asked to share what they notice and wonder about the image or situation. Students are encouraged to notice and wonder about both math-related and non-math-related aspects of the image or situation.

This is primarily a whole-class, discussion-based brainstorming activity, one in which the noticings and wonderings of one student help spark additional noticings and wonderings among other students. Students should not be expected to write down what they notice and wonder; rather, the routine works better when students are more spontaneous and can respond to one another's comments.

As students share, the teacher may want to record students' noticings and wonderings for all to see and to avoid redundancy of ideas. Allow for some non-math-related observations and questions, but eventually pose questions to get students thinking about a math focus. The support in the Teacher Edition offers prompts that can focus students' thinking on a math focus.

These activities are low floor-high ceiling activities and it is important that all students feel comfortable participating and valued for their participation.

Variations of the *Notice & Wonder* routine include:

- Tell me everything you can.
- What question could you ask?
- What could the question be?

How are they the same? How are they different?

In this variation of the routine, students are presented with two or more images or situations and consider how the images or situations are similar and different. The students share similarities and differences, some of which may be mathematical in nature, others non-mathematical.

As with the *Notice & Wonder* routine, this is also primarily a whole-class, discussion-based activity. As students can share both mathematical and non-mathematical similarities and differences, the teacher can record these for reference. If students do not bring up the intended math focus, prompts in the Teacher Edition can get students thinking about the focus.

Which Doesn't Belong?

Students are presented with a series of images, quantities, or numbers – usually four, and think about the question, “Which doesn't belong?” The activity has been designed to have multiple responses depending on which criteria or attribute the student is considering. Students are encouraged to think about as many different ways to identify the one that does not belong.

As students share their responses, they should be encouraged to share their reasoning for which one does not belong.

Guidance in the Teacher Edition can help the teacher direct students' thinking to the specific math focus for the lesson.

Is It Always True?

Students are presented with one or more images or situations and think about the relationship among the objects in the image or situation. Students then consider whether the relationship always holds or whether it/they are unique to the image or situation.

As with the other sense-making routines, this is primarily a whole-class, discussion-based brainstorming activity, one in which students share their thoughts around the generalizability of the relationship and their reasoning for their claims. As with the other routines, students should not be expected to write down their thoughts and reasoning; rather, the routine works better when students are more spontaneous and can respond to one another's comments. However, some learners may need to make written notes to capture their thoughts and should feel free to do so.

Guidance in the Teacher Edition can help the teacher direct students' thinking to the specific math focus for the lesson that the sense-making routine is targeting.

Numberless Word Problems

Students are presented with a scenario or problem situation that suggests operations, but with no numbers. That is, instead of specifying quantities, the scenario or problem would indicate “some.” For example, “Some dogs are in the dog park. Some dogs come into the dog park. Then some dogs leave the dog park.” Students are expected to make sense of what is being described in the situation and explain which operations it represents. Without numbers, students are able to develop a better understanding of the underlying structure of the problem itself.

The prompts in the Teacher Edition offer options to extend and expand the discussion about the situation presented.

Number Routines

About How Much?

Purpose Build estimating skills.

Overview Students estimate the value of expressions (with operations) shown, explaining their strategies and thinking. The teacher records students' estimates, then reveals the value of the expression. Students analyze the estimates and discuss which are closest to the actual value of the expression.

Can You Make the Number?

Purpose Build flexible thinking and efficiency with operations.

Overview Students use all the numbers given to build expressions with a value of the target number. Students can use a range of operations in their expressions. The teacher records students' expressions, then facilitates a discussion about students' expressions.

Decompose It

Purpose Build flexibility with numbers and proficiency with number sense.

Overview Students come up with multiple (at least 3) ways to decompose given numbers and share their thinking for each decomposition. The teacher records sample decompositions then facilitates a discussion of patterns students notice in the decompositions.

Find the Missing Values

Purpose Build their identification of patterns and their efficiency with solving equations as they examine a list of related equations.

Overview Students analyze a series of equations to look for patterns that they can use to determine the missing values in the equations. As students share their analyses and solutions, the teacher can reveal the missing values.

Find the Pattern, Make a Pattern

Purpose Build efficiency with recognizing and building patterns.

Overview Students determine the rule(s) for a given pattern, then use the rule(s) to continue the pattern or create a new pattern. The teacher records students' new patterns and facilitates a discussion to validate the pattern and its rules.

Greater Than, Less Than

Purpose Build proficiency with number and place value sense; estimating and comparing skills.

Overview Students use mental math to estimate or evaluate the value of given expressions and then compare the value of the expressions to a target benchmark number. Students share their solutions and thinking.

Let's Count (Pattern Count)

Purpose Build proficiency with skip counting.

Overview Given a starting number and a counting interval, students count forward or backward. Before beginning the counting sequence, students predict numbers that will be included in the counting sequence.

Math Pictures

Purpose Build number sense and mathematical awareness.

Overview Students respond to a prompt about an image.

Mystery Number

Purpose Builds mathematical reasoning and thinking.

Overview Based on clues that are revealed one at a time, students determine the mystery number. With each clue, students propose possible solutions and eliminate proposed solutions that are no longer viable. The teacher records student's proposed solutions and delete from the list those proposed solutions that are eliminated based on the clues.

What's Another Way to Write It?

Purpose Build flexibility with number sense and mental math operations.

Overview Given an expression, students come up with alternative expressions using the same or different operations that, when evaluated, have the same value. The teacher records expressions as students share. Students then look for relationships amongst the shared expressions.

Where Does It Go?

Purpose Build estimating skills using benchmarks.

Overview Students place a target number on number lines with different endpoints and justify their placement. In some instances, as a challenge, the target number may not actually belong on one of the number lines.

Would You Rather?

Purpose Build flexibility with number sense and mental math operations; enhance decision-making.

Overview Students choose between two options, both of which require mental computation. Students explain their choice and their rationale for their choice.

Math Language Routines

MLR 1 Stronger and Clearer Each Time

Purpose To provide opportunities for students to revise and refine both their ideas and their verbal and written output (Zwiers, 2014).

Successive Pair Shares Students respond to a prompt either verbally or in writing. Then, students share their responses and their reasoning through successive pair shares, refining and revising their response after each pair share. Student-pairs are expected to provide details and to press their partners to provide details around their thinking. Students revise their responses after each pair-share, incorporating as appropriate new ideas or language.

Convince Yourself, a Friend, a Skeptic Students think about an argument for three different audiences. They first justify the argument in a way that makes sense to them, then, they explain *what* they know and think and *how* they know their argument is true to a classmate. For their third audience, students explain *why* they know their argument is true to a different classmate. Students' arguments may include words, pictures, numbers, and examples. Students should be prepared to offer counter-arguments.

MLR 2 Collect and Display

Purpose To help students build vocabulary and language when engaging in mathematical discourse.

Gather and Show Student Discourse (Dieckmann, 2017) While students are working in pairs or small groups, the teacher circulates and listens to student talk, capturing common or important words and phrases. The teacher organizes words and phrases captured in a visual display that the teacher and students can reference throughout the unit of study. The teacher can update and add to the visual display to show refinement in language students are using to discuss key concepts.

Number Talks (Humphreys & Parker, 2015) Number Talks have four parts (1) Students are presented with a numeracy problem that they consider without written solution for a few minutes; (2) Students share their strategy for solving and their thinking about their strategy; (3) As students share their strategies and thinking, the teacher creates a visual display of students' strategies and thinking, noting common or important words or phrases shared; (4) The teacher facilitates a discussion analyzing the strategies and thinking, their benefits and drawbacks in different types of situations.

MLR 3 Critique, Correct, and Clarify

Purpose To have students analyze and reflect on a written or verbal mathematical argument.

Critique a Partial or Flawed Response The teacher presents a partial or flawed argument, explanation, or solution and has students come up with ways to complete or fix the argument. Students can work individually or in pairs to propose improvements and/or additions to the argument. Students share their responses with a partner and based on feedback from their partner, they refine and revise their responses.

Always, Sometimes, Never The teacher presents a mathematical statement that students analyze to decide whether it is always, sometimes, or never true. If possible, the teacher presents the statement in a graphic organizer that can then be used to assess students' reasoning.

MLR 4 Information Gap

Purpose To create a need for students to communicate (Gibbons, 2002).

Info Gap Cards Each student-pair has two cards, Student A has Card A with the problem statement and Student B has Card B with data or information needed to solve the problem. Student A asks Student B for specific information that is needed to solve the problem. Before providing the information, Student B asks Student A to justify the need for information before providing the information requested (if available). Student A then explains how he or she will use the information to solve the problem.

Info Gap Games Student-pairs play a guessing or matching game). Student A shares the information and Student B uses his or her understanding of math concepts to guess what Student A is describing. For example, Student A may identify objects in the classroom that share a shape and Student B guesses the shape.

MLR 5 Co-Craft Questions and Problems

Purpose To allow students to use conversation skills and mathematical language to generate questions, problems, and situations

Co-Craft Questions The teacher presents a scenario or part of a problem context and students come up with math-related questions that could be asked about the situation. Student-pairs share their questions, comparing and contrasting the questions each asked. The teacher can then facilitate a share-out of questions from the class, after which the actual question students will look to answer is revealed.

Co-Craft Problems Student-pairs work together to co-create problems. Student-pairs then solve their problems, and trade problems with another student-pair. Student-pairs solve the problems of others, checking their solution against that of the co-creators.

Co-Craft Situations The teacher presents a mathematical representation with no labels. Students work individually to write a story or scenario that matches the representation. Students then work with a partner to share their scenarios or situations, each explaining how their situations reflect the mathematical representation. Based on feedback from their partners, students revise their situations, adding details as appropriate.

MLR 6 Three Reads

Purpose To ensure that students make sense of problem situations and equip them with tools used to negotiate meaning (Kelemanik, Lucenta & Creighton, 2016).

Three Reads Students read a problem situation or scenario three times, each time with a different focus (1) Students read for comprehension, to understand the problem situation; (2) Students focus on the language used to present the mathematics with the goal of understanding what mathematics is most appropriate to use; (3) students think about which strategy or solution method would be appropriate.

Values/Units Chart (1) Students read through text and underline any words or phrases that represent a known or unknown value or amount . (2) They list these numbers, unknowns, and variables in the left column of their graphic organizer (Values). (3) After reading a second time, students write the meaning of the values in the right column of the graphic organizer (Units). (4) After the third read, students work in pairs to create mathematical expressions using only the right column.

MLR 7 Compare and Connect

Purpose To foster students' meta-awareness as they identify, compare, and contrast different mathematical approaches, representations, concepts, examples, and language.

Compare and Contrast Solution Strategies Students are given a problem to solve on their own. Students are then paired up and share their solution strategies with their partners, relating and connecting their partner's approach to their own approach. Some options include

- 1. Divide and conquer** Set students in pairs before they solve the problem. Each pair decides on two different ways to solve the problem; one partner does one way and the other partner does the other way.
- 2. What is similar, what is different** After student-pairs share solution strategies, they identify what is similar and what is different about the approaches. Students can also discuss what worked with each approach.
- 3. Mathematical focus** Student-pairs focus on specific mathematical relationships, operations, quantities and values.

Which One Doesn't Belong? Students are provided with sets of four numbers, equations, expressions, graphs, or geometric figures. Working in pairs, students decide together how to group the sets so that three of the items fit within a category they have created and one does not. Both partners should be prepared to explain to a different group how they agreed on a category and justify which item did not fit.

MLR 8 Discussion Supports

Purpose To facilitate rich discussions about mathematical ideas, representations, contexts, and strategies (Chapin, O'Connor, & Anderson, 2009).

Whole Class Discussion Supports During whole class discussion, the teacher can use these strategies to support mathematical discourse

- **Restating** The teacher restates students' ideas as questions to clarify meaning and model appropriate mathematical language
- **Press for Details** The teacher asks students to elaborate on an idea, expand an argument, or give an example.
- **Think Alouds** The teacher talks through their thinking about a mathematical concept.
- **Use multiple modalities** The teacher uses different modalities to show concepts.
- **Choral responses** The teacher has students practice common or important words or phrases through choral repetition.

Numbered Heads Together (1) The teacher has students count off by 4s (or the number of students he or she wants to have in a group. (2) The teacher then presents a question or problem and has students work in their groups according to their number to come up with an explanation or justification. (3) Each group reporter shares the group explanation and/or agree or disagree with the previous group reporter. Other members of the group are not allowed to talk or write, but the reporter can use the notes from the group discussion. The correct answer, if there is one, is revealed once all groups have presented.