


Breakout Workshops

K–Grade 2

Essential Understandings for K–Grade 2 Students: Composition and Decomposition
Composition and decomposition are two powerful ideas that are essential to foster in early elementary mathematics. The flexibility of being able to combine and partition units contributes to a student's mathematical success. This interactive workshop will explore foundational ideas of composing and decomposing in the context of number and operations, geometry, and measurement. Pedagogical implications will be explored highlighting the Standards for Mathematical Practice to "Attend to precision" (SMP 6) and "Construct viable arguments and critique the reasoning of others" (SMP 3).

Supporting Young Learners to Develop Understanding through Problem Solving
Young children have strong, innate problem-solving skills, although many primary students come up short when solving problems because they often rely on unproductive methods. Mathematics instruction in early elementary school must help students develop an understanding of the problem-solving process and reason abstractly and quantitatively through contextualizing/decontextualizing the situation (SMP 2). Attention should also be given to developing student dispositions that value cognitive disequilibrium, making mistakes, and perseverance (SMP 1). Participants will be encouraged to think deeply about intentional pedagogical strategies that contribute to developing young, confident problem solvers and gather ideas to implement in their own classrooms.

Speaker: Susie Katt

Building a Foundation for Later Grades: Addition and Subtraction
Developing a robust understanding of addition and subtraction begins in the early primary grades. This hands-on workshop will include analysis of addition and subtraction problem types and exploration of different ways to reason about addition and subtraction situations. A young mathematician's ability to contextualize, decontextualize, and model additive relationships supports flexibility and fluency with operations. Participants will discuss how such understanding better prepares students for the more complex mathematics they will encounter in subsequent grades.

Building a Foundation for Later Grades: Number and Base Ten
A deep understanding of the structure of our number system is a fundamental building block for developing operations in base ten. This hands-on workshop will explore ways to bring students' attention to patterns in place value. Participants will discuss how deep understanding of place value relationships in the early grades can build flexibility with number concepts, which in turn better supports fluency and flexibility with greater numbers and base-ten operations in later grades.

Speaker: Delise Andrews

Concentration on Compensation (not the paycheck kind!)
In this workshop, we will explore the underlying number sense necessary for students to understand the "Big Idea" of compensation and for them to use the powerful mental math strategies rooted in this concept. We will examine the trajectory of students' mathematical development and see how we can use a variety of resources including context-based units, quick images, number talks, games, and digital resources to provide opportunities for learning. We will also share strategies for turning classrooms into communities of mathematicians by implementing tasks that promote reasoning and problem solving, using and connecting mathematical representations, supporting productive struggle, and eliciting and using evidence of student thinking.

"That one's an upside-down triangle!"
In this workshop, we will focus on moving beyond children's naming of shapes to a true understanding of the connection between directional and Euclidian geometry and see how this relationship can provide a meaningful foundation for coding. We will examine the developmental trajectory of students' understanding of geometry and see how we can use a variety of resources including context-based units, quick images, games, and digital resources to provide opportunities for learning. We will also share strategies for turning classrooms into communities of mathematicians by implementing tasks that promote reasoning and problem solving, facilitating meaningful discourse, posing purposeful questions, and supporting productive struggle.

Speaker: Susanna Stossel

Grades 3–5

To Think or Not to Think
"Did I get it right?" "Is this correct?" "Is this the right answer?" Questions like these are a sure sign that our students are too interested in being "answer-getters" and lack mathematical confidence. In this workshop, participants will complete activities for grades 3–5 designed to refocus students' thinking on the hows and whys of problem solving. With activities like these, students will develop self-check skills that will bring confidence and, ultimately, self-motivation.

?gnihtynA ecitoN uoY oD
What motivates students to understand math? A number of factors can play a part, but the most effective and longest-lasting stimulus is internal. Tuning students in to the exciting world of pattern-based mathematics will turn on this self-motivation. Once they begin looking for patterns, they will find them everywhere. In this workshop, participants will complete activities for grades 3–5 designed to draw student interest into the fascinating world of patterns. With activities like these, it's difficult to see how anyone could be a math hater.

Speaker: Jason Chamberlain

Seeing the World Through Mathematics & Social Justice
In Rethinking Mathematics (2013), Gutstein and Peterson assert, "Students can recognize the power of mathematics as an essential analytical tool to understand and potentially change the world, rather than merely regarding math as a collection of disconnected rules to be rotely memorized and regurgitated." Come to this session to engage in a mathematics task that prompts students to devise their own approach and strategy to investigate the world around them; communicate their mathematical findings; and take an active role in understanding, engaging in, and changing the world.

Fair Share: Building on Students' Experiences to Support Understanding of Fractions
How might students' experiences with addition and multiplication of whole numbers, geometrical shapes, and problem solving support fractions concepts? This session will engage participants in tasks and reflection about how to support children's understanding of fractions by building on prior experience and students' thinking.

Speaker: Carolee Koehn Hurtado

Deriving Fraction Algorithms through Making Use of Structure & Regularity
Come join us for some fun with play-doh and fraction operations! Participants will move from the concrete to the pictoral to the abstract by (1) building an area model with play-doh, (2) drawing visual models, and (3) deriving the algorithms for multiplication and division of fractions. Conceptual understanding will be established first using the area model and number line in context. Participants will then use math practice 7 to identify a pattern or structure. Participants will use math practice 8 to observe calculations that repeat to then generalize with an algorithm. Math practice 3 will be used to justify conclusions. The goals of this session include participants leaving with a greater understanding of (1) math practices 3, 7, and 8, (2) multiplication and division of fractions content in CCSSM, and (3) methods to engage students in the content and classroom discourse.

Raising Money for Children's Hospital—A Mathematical Modeling Task
In order to raise $1,000,000 for Children's Hospital, should a toy store ask it's customers to donate whole dollar amounts of $1, $5, or $10 OR request that customers donate the change needed to increase their total bill to the next full dollar amount? Join us for an authentic modeling task where participants will engage in real world problem solving. This will be accomplished through making assumptions, researching additional needed information, formulating a plan, and reporting out their findings. The goals of this session include participants leaving with a greater understanding of: 1) math practice #4 2) how to implement a modeling task related to decimal operations 3) methods to engage students in the content and classroom discourse.

Speaker: Janna Canzone

Grades 6–8

High Leverage Practices to Support Number Sense and Algebraic Reasoning
Do number sense routines really have a place in the middle school math classroom? Of course they do! Number sense routines engage our middle school students in algebraic thinking as they explore mathematical patterns and relationships, which is foundational for mathematical literacy beyond the walls of school. Join us as we explore high-leverage practices that provide opportunities for students to develop fluency, flexibility, and the ability to reason with numbers.

Extending Algebraic Thinking and Reasoning: Let's Tile A Pool!
In this session, we will build on our exploration of mathematical patterns and relationships as we tile a pool. Through this engaging activity, students in grades 6–8 are challenged to describe, represent, and generalize their mathematical thinking in a real-world context. Participants will leave this interactive session with ideas of how to implement effective tasks that promote algebraic reasoning and problem solving in the middle school classroom.

Speaker: Janene Ward

Diagrams as Problem-Solving and Communication Tools for English Learners
Creating and analyzing mathematical diagrams can support students' mathematical thinking and their mathematical communication in line with the mathematical practices. In this session, we will explore how to support English language learners (ELLs) to use diagrams for problem solving in ratio and proportion contexts. We will discuss language support strategies that can be integrated into work with diagrams and will consider implications for tailoring those strategies to the needs and strengths of students. Participants will have opportunities to engage with diagramming, analyze example ELL student work, and consider instructional decisions about how to support ELLs in the classroom.

Understanding and Planning for Mathematical Practices in Geometry Lessons
This session will explore mathematical thinking and communication in geometry contexts that reflect the Standards for Mathematical Practice, focusing particularly on making sense of problems and persevering in solving them (SMP 1), using appropriate tools strategically (SMP 5), and looking for and making use of structure (SMP 7). Participants will engage with a rich geometry task to examine what mathematical practices look like in a geometric context. They will then consider implications for planning goals related to the mathematical practices in geometry, instructional questions, and how to support students' productive struggle in geometry. Questions focused on the mathematical practices will be shared as a resource.

Speaker: Johannah Nikula

Teach Structural Thinking within Expressions and Equations, while Developing Precision in Language

The Standards for Mathematical Practice, along with the NCTM Process Standards, raise the expectations for classroom practices and student learning. In particular, CCSSM emphasizes mathematical structure in both content and practice standards. Although the articulation of such thinking is relatively new, teachers do not need new curriculum to develop structural thinking in their students. Structural thinking lies in three actionable steps—chunk, change, and connect. Participants will experience and learn an instructional routine, Connecting Representations. By design, it provides access to a wide range of learners, integrating high-leverage, research-based pedagogies to develop structural thinking *all* students.

Teach Structural Thinking within Statistics and Probability, while Developing Precision in Language

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Speaker: Amy Lucenta

Help Students Understand Ratios and Proportional Relationships with Rich Activities
Understanding ratios and proportional relationships is an important journey for students. We will use rich contextual tasks and engaging activities to help students strengthen their understanding throughout their journey. Come explore the importance of making sense of problems, multiple representations, and the ability to reason abstractly and quantitatively about ratios and proportional relationships.

Give Students Engaging Tasks to Make Sense of Geometry
Making sense of geometric properties and constructing viable arguments is an important journey for students. We will use concrete examples and participate in engaging tasks that help students better understand geometric relationships and strengthen their ability to articulate their reasoning while modeling with mathematics and problem solving.

Speaker: Andrew Stadel

Capturing Quantities: An Instructional Routine to Foster SMP 2

Reasoninging abstractly and quantitatively (SMP 2) is one of three math practices that define a type of mathematical reasoning that students can learn and apply. But how do we help them get there? Through math practice instructional routines! These routines describe a set of repeatable steps and behaviors that can help students focus on the mathematical reasoning characterized by a particular math practice. In this workshop, participants will learn about two foundational ideas and several key instructional questions that characterize SMP 2. Participants will then learn an instructional routine that builds students' capacity to reason quantitatively and abstractly (SMP 2). They will also learn how the Capturing Quantities routine leverages best practices, including NCTM teaching practices, to support struggling learners.

Speaker: Grace Kelemanik

Deep Dive Strands

K– Grade 2 Number & Operations

Session 1

Place-Value Structure of Numbers
"Why isn't fifty-ten the number after fifty-nine?" Explore the ways young children make sense of spoken and written numbers. Using teacher-written narratives describing events from their own classrooms and digging into the mathematics for ourselves, we will analyze the mathematical understandings necessary to make sense of multidigit numbers. The session will also include opportunities to consider the implications for K–grade 2 teachers of the NCTM Effective Mathematics Teaching Practices and the Standards for Mathematical Practice from the Common Core.

Session 2

Making Sense of Addition Strategies
"First I splitted it into tens and ones." Examine how the strategies that children develop for addition call on the place-value structure of the base-ten number system. Using teacher-written narratives and video clips of students explaining their approaches, we will analyze strategies for addition and explore the mathematical concepts that underlie them. The session will also include opportunities to consider the implications for K–grade 2 teachers of the NCTM Effective Mathematics Teaching Practices and the Standards for Mathematical Practice from the Common Core.

Session 3

Making Sense of Subtraction Strategies
"To find 40 – 18, first I thought about how many I had and how many more I needed to get to 40." Examine how the strategies that children develop for subtraction call on the place-value structure of the base-ten number system as well as the relationship between addition and subtraction. Using teacher-written narratives and video clips of students explaining their approaches, we will analyze strategies for subtraction and explore the mathematical ideas that underlie them. The session will also include opportunities to consider the implications for K–grade 2 teachers of the NCTM Effective Mathematics Teaching Practices and the Standards for Mathematical Practice from the Common Core.

Facilitators:

Virginia Bastable

Deborah Shifter

Grades 3–5 Fractions/Rational Number

Session 1

Understanding the Number Line: How Linear Measurement Extends from Whole to Rational Numbers
Why do we have third graders place fractional values on the number line? What do we hope they will gain from this task? This session will argue that because the number line is abstract, for students to understand a fraction on the number line, they must (1) have a robust understanding of finite linear measurement, (2) have experiences working on complex whole-number tasks on the number line, and (3) be able to connect other diagrammatic and contextual representations of rational numbers to the number line. Participants will explore tasks that use linear measurement to develop in students an early understanding of fractions. This understanding will also be used to think of how the measurement construct connects to the idea of "unit" and the multiple interpretations of fractions. This session will focus on the first Big Idea from NCTM's *Essential Understanding* book on fractions and on MTP5, building procedural fluency from conceptual understanding.

Session 2

Is 3 × 5 the same as 5 × 3? Using Precise Notation to Explore the Structure of Multiplication
Why does CCSSM specifically define "*a* × *b*" as "*a* copies of *b*"? Although the whole-number implications may seem thin, the rational-number implications are somewhat important. How can you model and find the product of 6 copies of 1 1/2? Does the model of 1 1/2 copies of 6 look the same? Students who discover that these products are the same through models and contexts can actually be left in awe of commutativity—not taking it as a predefined quality of multiplication. Using linear measurement diagrams and the number line, participants will look at a progression of multiplication problems with increasingly complex structure. They will then discuss how students can move from one step to the next. After analyzing the structure of these products, participants will consider implications for early instruction of multiplication. This session will focus on the fourth Big Idea form NCTM's *Essential Understanding* book on fractions and on MTP3, use and connect mathematical representations.

Session 3

From Interpretation to Algorithms: Using Contexts to Develop Two Different Fraction-Division Algorithms
What does it mean to define division as "the inverse of multiplication"? When can we interpret *a* ÷ *b* as the solution to ___ × *b* = *a* and when as *b* × ___ = *a*? Participants will look at a variety of contexts that can lead students to a robust understanding of contextual and noncontextual rational-number division. They will then look at how the different interpretations (when developed through sense making) lead to two different algorithms—either the common-denominator algorithm or the invert-and-multiply algorithm. Participants will see why these are generalizations of student-generated processes. This understanding will then be used to consider how division can be introduced in earlier elementary grades. Specifically, participants will look at ways of developing symbolic notation for division. We will also look at strategies of how to help students decide between partitive and quotative division, even in noncontextual (whole-number and rational number) situations. This session will focus on the fourth Big Idea from NCTM's Essential Understanding book series on fractions and on MTP1, establish mathematics goals to focus learning.

Facilitators:

Mina Kim

Ryan Casey

6–8 Ratio/Proportional Reasoning

Session 1

Developing Pedagogical Content Knowledge
We will take a look at the Big Idea and essential understandings for ratios, proportions, and proportional reasoning and how these understandings can support our content expertise and structure our instructional strategies. We will examine the four components of pedagogical content knowledge and use them as a framework for each task specifically and for the unit as a whole. We will do a few tasks and examine students' work as we proceed toward the big idea of ratios and proportions.

Session 2

Working toward Essential Understandings 3 and 7
There are ten essential understandings for ratios, proportions, and proportional reasoning, but we will focus on four of these understandings, two today and two tomorrow. We will work toward Essential Understanding 3 by examining tasks that have quantitative attributes (direct measurements) as well as relational attributes (probability and speed). We will also work toward Essential Understanding 7 by examining students' reasoning and understanding of equivalent ratios, proportional relationships, and the relationship between multiplicative comparisons and composed units. We will work through some tasks that challenge our own thinking about these attributes.

Session 3

Working toward Essential Understandings 8 and 9
We will work toward Essential Understanding 8 by defining the terms ratio and rate and finding ways to help students develop their own conceptions on which they may build future understandings. Essential Understanding 9 states, "Several ways of reasoning, all grounded in sense making, can be generalized into algorithms for solving proportion problems." We will work toward this understanding by highlighting students' work that demonstrates how they can "reason abstractly and quantitatively." We will wrap up our session by looking at the key concepts in ratios and proportions that are covered before and after grades 6–8.

Facilitator:

Fawn Nguyen

6–8 Statistics & Probability

Session 1

Data Variability
This workshop will start by having participants collect and record data about themselves (e.g., height, shoe size, distance from home, number of TVs, cubit length) on chart paper posted around the room. After the data has been collected, the participants will study the statistical reasoning process as outlined in the Guidelines for Assessment and Instruction in Statistics Education (GAISE). This workshop will emphasize the statistics standards in the sixth-grade Common Core Standards, particularly, analyzing a set of data that has a distribution that can be described by its center, spread, and overall shape. The context for collecting the data is measuring each person's cubit, the length of the forearm from the elbow to the end of the middle finger. These data will be recorded and used to create a human box-and-whisker-plot. Participants will find the minimum, maximum, median, upper quartile, and lower quartile of the data. Participants will calculate the inner quartile range and determine if the data has any outliers. If enough participants are present, box-and-whisker plots will be made for each gender and compared. The participants will respond to a number of questions about the data distributions. The participants will discuss do an idea wave to review the important ideas in the activity and support language development.

Session 2

Investigating Chance
This workshop will provide an opportunity for participants to explore theoretical and experimental probability. The participants will play two different two-dice games. In the first game, two dice are rolled. If the sum is even, player 1 gets a point. If the sum is odd, player 2 gets a point. Participants will play at least twenty rounds of the game and record their results in a table. The participants will calculate the experimental probability for an even sum and an odd sum. In the second game, two dice are rolled. If the product is even, player 1 gets a point. If the product is odd, player 2 gets a point. Participants will play at least twenty rounds of the game and record their results in a table. The participants will calculate the experimental probability for an even sum and an odd product. Next, the participants will analyze the games by looking at the possible outcomes for each game and calculating the theoretical probability for each outcome. The participants will connect this activity to the GAISE statistical reasoning process and discuss the implications for classroom implementation.

Session 3

Investigations Bi-Variate Data
In the first workshop, the participants recorded their height (in inches) and their shoe size in a table. Participants will use the data height and shoe size that was collected in the first workshop to create a scatter plot. The scatter plot will be used to create a line of best fit for the data. The participants will calculate the equation of the line of best fit and then will use the equation of the line of best fit to calculate their shoe size given their height in inches. Participants will compare their results to determine whose equation did the best job of calculating shoe size from height. Participants will use their equations to calculate the shoe sizes of the world's tallest man and woman. The participants will have a discussion about whether using height as a predictor of shoe size is reasonable. The session will end with an idea wave on scatter plots.

Facilitator:

Kyndall Brown