IM K-5 Math™ v.1

certified by Illustrative Mathematics®

The final piece to a fully aligned K-12 curriculum

@IllustrateMath  Illustrative Mathematics  #LearnWithIM
Today’s Presenters

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Grade 5 Lead Writer K-5 Math
Illustrative Mathematics

Sarah believes that all students learn math by doing math together, and sees great value in listening to students’ ideas. She started her teaching career on an island off the coast of Maine, teaching in a K–8 one-room schoolhouse, then she spent four years teaching grade 4. Since 2001 she has been a K–12 math coach and coordinator, and she also presents professional development at local, state, and national conferences.

At IM, she facilitated professional learning for the Illustrative Mathematics Middle School Curriculum, and her work as a Grade 5 Lead puts her passion for listening and collaboration at the heart of every lesson she designs, teaches, and places in a teacher’s hand.
A seamless, coherent, and aligned mathematical experience
Creating a world where all learners know, use, and enjoy mathematics
In the chat, respond to the following question:

What does it mean for a curriculum to support *all learners*?
Equitable Practice and Structures

- Culturally Diverse Contexts
- Invitational
- Advancing Student Thinking Suggestions
- Responding to Student Thinking Suggestions
- Teacher Reflection Questions
- Collaborative
- Lesson Launch Adaptations
“The tools and adaptations to meet the needs of diverse learners are written right into the curriculum. All students are welcomed into the math with accessible routines and materials.”

“Students are talking about math like they never have before and students who would typically not speak up in math class now join the conversation.”
Discussion Topics

● Problem-based Lesson Structure
● The Student Experience
● The Teacher Experience
● K-5 Curriculum Assessment
● Supporting Student Learning
● Learning Through the Work of Teaching
Problem-based Curriculum
Why problem-based curriculum?

“Students learn mathematics as a result of solving problems. Mathematical ideas are the *outcomes* of the problem-solving experience rather than the elements that must be taught before problem solving.”

Hiebert, J., et. al. (1996).
Problem solving as a basis for reform in curriculum and instruction
Problem-based curriculum

Students...

- have invitational and accessible entry points
- work on activities individually and in groups
- take various approaches to problems

Teachers...

- ensure students understand the problem from the start
- listen and learn from student work and discussions
- synthesize learning at the end of each activity and lesson
Overarching Design Structure

- Invitation to the mathematics
- Deep study of concepts and procedures
- Consolidating and applying
Structure of a 60-minute Lesson

Grades K-1

Warm-up
Activity
Activity Synthesis
Lesson Synthesis

Cool-down
Centers

Grades 2-5

Warm-up
Activity
Activity Synthesis
Lesson Synthesis
Cool-down

Centers
Structure of Materials

Lesson 3
Prime and Composite Numbers

Standards Alignment
Addressing: 4.OA.B.4

Teacher-facing Learning Goals
- Determine whether a given whole number in the range 1-100 is prime or composite using rectangles. Find the factor pairs of a given whole number 1-100.

Student-facing Learning Goals
- Let's identify prime and composite numbers.

The purpose of this lesson is for students to identify factor pairs to determine whether a given whole number in the range 1-100 is prime or composite.

In previous lessons, students were introduced to multiples and factor pairs.

The purpose of this lesson is for students to determine whether numbers are prime or composite and justify their reasoning within the context of area (MP3). Students use their knowledge of area and factor pairs to learn that certain whole numbers have exactly 1 factor pair, the number and 1 (prime numbers), while others have more than 1 factor pair (composite numbers).

Math Community
Tell students that, at the end of the lesson, they will be asked to identify specific actions from their "Doing Math" list (both teacher and student sections) they personally experienced.

Access for Students with Disabilities (SWD)
Activity 1: Engagement

Instructional Routines
Card sort

Materials to Gather
inch tiles and grid paper, as needed

Lesson Timeline
- Warm Up: 10 min
- Activity 1: 20 min
- Activity 2: 15 min
- Lesson Synthesis: 10 min
- Cool-down: 5 min

Materials to Copy
Create a set of cards from 4.1.A.3.BLM for each group of 2 students.

Teacher Reflection Question
Who participated in math class today? What assumptions are you making about those who did not participate? How can you leverage each of your students’ ideas to support them in being seen and heard in tomorrow’s math class?
The Student Experience
Let’s count square tiles.
Warm Up: Which One Doesn’t Belong

A

B

C

D
Activity 1: Time to Tile

Describe or show how to use the square tiles to measure the area of each rectangle. You can place square tiles on the handout where squares are already shown. You can also move the tiles, if needed.
Activity 1: Synthesis

“Why did the square tiles in some of the rectangles need to be adjusted before we could finish finding the area of the rectangle?”
Activity 2: Card Sort: Rectangles Launch

What do you notice? What do you wonder?
Activity 2: Card Sort: Rectangles

Your teacher will give you a set of cards that show rectangles. Sort the cards into categories of your choosing. Be prepared to explain your categories.

Examples:
Activity 2: Synthesis

“How did you sort the rectangles?”

"How did you decide that a rectangle belonged a category?"

"How did you know that the rectangle you created had the same area as the other rectangles in that category?"
Lesson Synthesis

“Today we learned we can draw squares in rectangles to represent tiling. We can count the squares to find the area of a rectangle just like we would count tiles.”

“What helpful features do rectangles have that help us find their area?”
Cool-down

Priya says this rectangle has an area of 23 square units because she covered it with 23 square tiles.

Do you agree with Priya? Explain or show your reasoning.
The Structure of a Lesson

Invitation to the mathematics

Which one doesn’t belong?

Deep study of concepts and procedures

Priya says this rectangle has an area of 23 square units because she covered it with 23 square tiles.

Consolidating and applying

Do you agree with Andre? Explain your reasoning.
K–5 Beta Experience

“There is curriculum has taken all of the fantastic instructional routines teachers were pulling from multiple sources and ties them up with a great big bow into a rigorous, coherent curriculum resource!”

“The clearly written ‘math story’ helps me know what has come before and how the material connects to what comes next.”
The Teacher Experience
Unit Breakdown

Grade 3 Unit 2: Area and Multiplication

Section A
Concepts of Area Measurement

Section B
Relate Area to Multiplication

Section C
Area of Figures Composed of Rectangles
Unit 2: Area and Multiplication

Unit Learning Goals

- Students learn about area concepts and relate area to multiplication and to addition.

In this unit, students are introduced to the concept of area as how much space a two-dimensional shape covers. Initially, students compare shapes directly to decide which covers more space. Students then work more precisely by tiling shapes using different units such as pattern blocks and square tiles. They learn the importance of tiling figures with no gaps or overlaps and count squares to determine the area of a rectangle.

Students relate the measurement of area to the operation of multiplication as they view rectangles as arrays of squares and see the rows and columns as equal groups. Then they explicitly connect the area of rectangles to multiplication expressions and understand that multiplying the side lengths of rectangles gives the same number as counting squares that tile a rectangle. Students are introduced to some standard area units: square inches, square centimeters, square feet, and square meters. They measure and multiply side lengths of rectangles to find area.

In the second section in this unit, representations progress from rectangles that are tiled or shown with full grids to partial grids, or from sides with tick marks to rectangles with only side length measurements. This facilitates the transition from counting squares to multiplying side lengths to find area. By the end of the section, students multiply side lengths to solve real-world and mathematical problems related to area.

\[ 6 \times 3 = 18 \]
Section A: Concepts of Area Measurement

Standards Alignments
Addressing 3.MD.C.5, 3.MD.C.5.a, 3.MD.C.5.b, 3.MD.C.6, 3.OA.A.1
Building Towards 3.MD.C.5

Section Learning Goals

- Describe area as the number of unit squares that cover a plane figure without gaps and overlaps.
- Measure the area of rectangles by counting unit squares.

In this section, students spend time reasoning about area as an attribute of two-dimensional shapes. They develop a sense of area as the amount of space covered by a shape. Then they tile shapes with squares. They learn that the area of a shape is the number of squares that are used to tile the shape with no gaps or overlaps.
Lesson Overview Page

Lesson 3: Let’s Tile Rectangles!

Standards Alignments
Addressing 3.MD.C.5.b, 3.MD.C.6

Teacher-facing Learning Goals
- Explain that rectangles that can be covered by the same number of unit squares without gaps or overlaps have the same area.
- Find the area of rectangles (within 24 square units) by counting unit squares.

Student-facing Learning Goals
- Let’s count square tiles.

Lesson Purpose
The purpose of this lesson is for students to measure area by counting square tiles and create rectangles with a given area.

In previous lessons, students learned that counting square tiles that cover a shape gives the area of the shape in square units. In this lesson, students further explore tiling and find the area of partially tiled rectangles. Students also create rectangles of a specific area to demonstrate they understand that rectangles covered by the same number of square tiles without gaps or overlaps have the same area.

Students should have access to square tiles throughout the lesson and also be encouraged to draw the partitioned rectangles they create with the tiles.

- **Students with Disabilities (SwD)**
  - Representation (Activity 2)

- **English Learners (EL)**
  - MLR8 (Activity 2)

Instructional Routines
Card Sort (Activity 2), MLR1 Stronger and Clearer Each Time (Activity 1), Which One Doesn’t Belong? (Warm-up)

Materials to Gather
- Inch tiles: Activity 1, Activity 2

Materials to Copy
- Time to Tile (groups of 1): Activity 1
- Rectangular Area Cards V1 (groups of 2): Activity 2

Lesson Timeline
- Warm-up: 10 min
- Activity 1: 15 min
- Activity 2: 20 min
- Lesson Synthesis: 10 min
- Cool-down: 5 min

Teacher Reflection Question
Reflect on students’ counting strategies. What strategies are they comfortable using as they find area? What strategies could use more practice?

Cool-down (to be completed at the end of the lesson)

Tile a Rectangle

Standards Alignments
Addressing 3.MD.C.5.b

Student-facing Task Statement
Andre says this rectangle has an area of 23 square units because he covered it with 23 square tiles.

Do you agree with Andre? Explain your reasoning.

Student Responses
Sample responses:
- No, even though it is 23 tiles, we don’t know that completely fills the rectangle because you can see some of the rectangle and some of the squares are overlapping.
- No, even though it is 23 tiles, you can see that some of the space in the rectangle isn’t covered.
Lesson Plan

2-column format

- Student view
- Teacher view

Warm-up
Which One Doesn't Belong: Tiles

10 min

Standards Alignments
Addressing 3.MD.C.6

The purpose of this warm-up is to draw students’ attention to different ways of covering a plane figure with squares and reinforce the idea that tiling involves covering a region without gaps and overlaps. It gives students a reason to use language precisely (MP6). It gives the teacher an opportunity to hear how students use terminology and talk about characteristics of the items in comparison to one another. During the synthesis, ask students to explain the meaning of any terminology they use, such as rows, columns, area, gaps, overlap, and tiling.

Instructional Routines
Which One Doesn't Belong?

Student-facing Task Statement
Which one doesn't belong?

Launch
- Groups of 2
- Display the image.
- “Pick one that doesn't belong. Be ready to share why it doesn't belong.”
- 1 minute; quiet think time

Activity
- “Discuss your thinking with your partner.”
- 2-3 minutes; partner discussion
- Share and record responses.

Synthesis
- “How could you use the squares in each of these rectangles to find the area of each rectangle?” (In C, I can just count the tiles. In B, I could finish tiling the rectangle and count the tiles. In D I would need to straighten out the rectangles to see how many tiles are in each. Finally, in A, I would need to count the tiles because I am unsure if there are any gaps between the tiles.)
“...it is an educative curriculum. Teachers are learning so much right along with their students.”

“My favorite part of math this year is everything.”
- 4th Grade Student

“It is the most inviting, rigorous and exciting curriculum I've ever taught...”
K-5 Curriculum Assessment
Opportunities for Assessment

1. Pre-unit Practice Problems
2. Cool-downs
3. Section Checkpoints
4. End-of-Unit Assessment
## Opportunities for Assessment

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- Pre-unit Practice
- Section Checkpoint
- Cool-down
- Section Checkpoint
- Cool-down
- Section Checkpoint
- Cool-down
- End of Unit
Pre-unit Practice Problems

Section A Practice Problems

1. Pre-unit

   a. Partition the rectangle into 4 equal rows and 5 equal columns.

   b. How many small squares are there in the rectangle?
Pre-unit Practice Problems

Pre-unit

How many dots are in each array? Explain your reasoning.

a.

b.
Cool-down: Where are the Squares?

The tick marks on the sides of the rectangle are 1 foot apart. What is the area of the rectangle? Explain or show your reasoning.

Next day support:
- During the launch of the next day's lesson, have students brainstorm together ways to find the total number of square units in a rectangle where no square units are visible.

Prior-unit support:
- Grade 2, Unit 3, Section A: Metric Measurement
Supporting Student Learning
What does it look and sound like to do math together as a mathematical community?

What norms, or expectations, should we be mindful of as we do math together in our mathematical community?
Equitable Practice and Structures

- Culturally Diverse Contexts
- Invitational
- Advancing Student Thinking Suggestions
- Responding to Student Thinking Suggestions
- Teacher Reflection Questions
- Lesson Launch Adaptations
- Collaborative
Instructional Routines

What do you know about ____?

Notice and Wonder
Instructional Routines

How Many Do You See?

Which One Doesn’t Belong?
Instructional Routines

True or False?

8 \times 20 = 8 \times 2 \times 10

8 \times 20 = 2 \times 8 \times 10

8 \times 20 = 16 \times 10

6 \times 20 = 12 \times 10

Estimation Exploration
# Instructional Routines

## Choral Count

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## Number Talk

- $5 \times \frac{1}{2}$
- $5 \times \frac{3}{2}$
- $6 \times \frac{1}{3}$
- $6 \times \frac{2}{3}$
Instructional Routines: Kindergarten

Act it Out

3 little ducks went out one day, over the hill and far away. Mother duck said, “Quack, quack, quack.” Then 3 little ducks came back.

Questions About Us

- “How can we figure out how many of us are here?” (We can count each person. We can count each circle in the 5-frame.)
- Count each student.
- “How many of us are here today?”
- Count each circle.
- “How many of us are here today?”
Practice Problems

Pre-unit

How many dots are in each array? Explain your reasoning.

a.

b.

Lesson-aligned

a. Find the area of each rectangle.

b. Can rectangles with different shapes have the same area? Explain your reasoning.

Exploration

Which shape has greater area, a green triangle pattern block or a tan rhombus pattern block? Explain your reasoning.
Purposes of Centers

- Meant for extra practice in school or outside of school
- Build fluency across a year (or any skill that develops over time)

By design, centers:
- are aligned to grade levels and units.
- consist of stages with the same general structure.
- can be repeated with different results each time.
- primarily focus on the major work of grade.
Two Types of Centers in a Unit

1. **Addressing** - Centers that address the work of the grade level unit.
2. **Supporting** - Reviews prior stages or supports ongoing fluency.

**Center: Capture Squares**

Students generate a number and connect 2 dots that are adjacent to the number. If that line closes the square, they capture it and shade it in their color. The player to shade in 3 squares first is the winner.

**Stage 1**
**Lessons:**
- Grade3.2.A1 (supporting)
- Grade3.2.A2 (supporting)

**Stage 2**
**Lessons:**
- Grade3.2.A3 (supporting)

**Stage 3**
**Lessons:**
- Grade3.2.B5 (addressing)
- Grade3.2.B6 (addressing)
- Grade3.2.B7 (addressing)

Addresses the current grade level
Supports for English Learners

- MLRs support language demands: reading, writing, speaking, listening, conversing, representing
- Structured but adaptable formats for amplifying, assessing, and developing students’ language.

MLRs:
- MLR1: Stronger and Clearer Each Time
- MLR2: Collect and Display
- MLR3: Clarify, Critique, Correct
- MLR4: Information Gap
- MLR5: Co-Craft Questions
- MLR6: Three Reads
- MLR7: Compare and Connect
- MLR8: Discussion Supports
Supports for Students with Disabilities

Areas of cognitive functioning

- Conceptual Processing
- Visual-spatial Processing
- Language
- Organization
- Memory
- Attention
- Social-emotional
- Fine-motor Skills
# Units By Grade Level: K–2

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| **2.1**     | Adding, Subtracting, and Working with Data                           |
| **2.2**     | Adding and Subtracting within 100                                    |
| **2.3**     | Measuring Length                                                    |
| **2.4**     | Addition and Subtraction on the Number Line                          |
| **2.5**     | Numbers to 1,000                                                     |
| **2.6**     | Geometry, Time and Money                                             |
| **2.7**     | Adding and Subtracting within 1,000                                  |
| **2.8**     | Equal Groups                                                         |
| **2.9**     | Putting it All Together                                              |
# Units By Grade Level: 3–5

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Learning Through the Work of Teaching
Learning Through the Work of Teaching

Four categories:

- Pedagogy
- Math Content
- Student Thinking
- Beliefs & Positioning
Curriculum: Educative Components

- Mathematical Narratives
- Teacher Reflection Questions
- Professional Learning Community (PLC) Activities
Mathematical Narratives

- Mathematical Narratives
  - Unit
  - Section
  - Lesson
  - Activity

Activity 1: ☺ 15 min

Counting Unit Squares

The purpose of this activity is for students to use the knowledge of unit squares gained in a prior lesson to build a shape with a certain area and to count unit squares to determine the area of the shape. Students take turns to create a shape or count the unit squares. Students should be encouraged to count efficiently by grouping or skip counting as practiced in number talks. In the synthesis, emphasis is on noticing that rectangular shapes or shapes made of rectangles (rectilinear shapes) are easier to count because the unit squares can be grouped.

Task Statement:
1. Partner1 creates a shape using 12 to 24 square tiles. Partner2 suggests a shape to your partner.
2. Partner1 explains how you could count the number of tiles within the shape to find the area.
3. Partner2 says yes or no, and repeat.
4. Who do you think were the squares you thought were easiest to count?

Student Responses:
- One partner creates a shape using the tiles.
- The other partner counts the tiles to find the area. (For example: 14 square units)
- The ones that had clear rectangles were easier to count because we could group the squares.

Launch/Activity:
- Groups of 2
- Give each pair 24 square tiles.
- "Now you will build and count shapes with your partner. Decide who will be partner A and who will be partner B."
- 8 minutes: partner work time
- Monitor for:
  - Increasingly efficient counting strategies (random counting, counting one-by-one, counting the outside squares first, counting along rows or columns)
  - Shapes that are easier for students to count.

Synthesis:
- "Which squares do you think were easiest to count?"


Unit 1 Narrative

In grade 3, students learned how to skip count by 5s and 10s and determined if a number was even or odd by lining objects or counting by 2s. They drew picture graphs and bar graphs with single-unit scales to represent a data set and represented forms of equal groups with arrays of up to 5 rows by 5 columns.

This unit allows students to build from grade 2 understanding of single-unit scales to represent a data set and learned about scaled graph. Students first engage with single-unit scaled picture and bar graphs to represent data. They then apply their grade 2 scale counting understanding to bar graphs with scales of 2, 5, and 10. When each picture or image represents more than one unit, students must understand that these are scaled unit graphs.
Teacher Reflection Question

Pedagogy
Which question did you ask today that best supported students’ understanding of area? What did students say or do that showed the question was effective?

Student Thinking
What strategies were students most comfortable using today?

Math Content
In grade 2, students skip counted by 2s, 5s, and 10s. In tomorrow’s lesson, record how students are building toward fluency in multiplication by 2s, 5s, and 10s.

Beliefs & Positioning
As students worked in small groups, whose ideas were heard, valued, and accepted? How can you adjust the group structure tomorrow to ensure each student’s ideas are a part of the collective learning?
PLC Activity: Section Narrative

PLC: Lesson 1, Activity 1, Compare Shapes

Suggested Centers

- Can You Build It? (3–5), Stage 1: Rectangles (support)
- Five in a Row: Multiplication (3–5), Stage 1: Factors 1–5 and 10 (reviewing)
- Can You Build It? (3–5), Stage 1: Rectangles (support)
- Five in a Row: Multiplication (3–5), Stage 1: Factors 1–5 and 10 (reviewing)
- Can You Build It? (3–5), Stage 1: Rectangles (support)
- Five in a Row: Multiplication (3–5), Stage 1: Factors 1–5 and 10 (reviewing)
Professional Learning: Topics

Explore a Lesson

Deep Dive Into Progressions and Representations

Explore Student Thinking

Planning and Learning with Teachers

Rehearse Routines
# K–12 Math Professional Learning

<table>
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<tr>
<th>Summer:</th>
<th>Fall:</th>
<th>Spring:</th>
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<tbody>
<tr>
<td>Two Full Days Onsite:</td>
<td>Two Sessions:</td>
<td>Two Sessions:</td>
</tr>
<tr>
<td>● over the Summer/early Fall</td>
<td>● One session for each grade span: K-2, 3-5</td>
<td>● One session for each grade span: K-2, 3-5</td>
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<tr>
<td>● Up to 25 participants per grade span: K-2, 3-5</td>
<td>● Content focused</td>
<td>● Content focused</td>
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Questions?

At the bottom of the screen, please submit questions using either the:

- Q&A Feature or
- Chat Feature

If we do not get to all of the questions, there is a webinar posted on the IM website.
THANK YOU

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By Maureen D. O’Connell

Building a Math Community with IM K–5 Math
By Tabitha Eutsler