Kindergarten Math Instruction Guide

Early math skills are important for children's long-term development and success in later grades. Mathematics helps children make sense of their world and develop critical thinking and problem-solving skills. The National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC) published a Joint Position Statement (2010) affirming that high-quality, challenging, and accessible mathematics education for 3- to 6-year-old children is a vital foundation for future mathematics learning. The ten research-based, essential recommendations to guide your classroom practice are:

1. Enhance children's natural interest in using mathematics to make sense of their world.
2. Build on children's background experience and knowledge.
3. Base instruction on knowledge of children's cognitive, linguistic, physical, and social-emotional development.
4. Strengthen children's problem-solving and reasoning processes, as well as representing, communicating, and connecting mathematical ideas.
5. Ensure a coherent curriculum that is compatible with sequences of important mathematical ideas.
6. Provide for children's deep and sustained interactions with mathematical ideas.
7. Integrate mathematics with other activities and other activities with mathematics.
8. Provide ample time, materials, and teacher support for children to engage in play where they explore mathematical ideas.
9. Use a range of experiences and teaching strategies to introduce mathematical concepts, methods, and language.
10. Support children's learning by thoughtful and continuous assessment.

Kindergarten Mathematical Domains

- **Counting and Cardinality:** number names; count sequence; count objects; group collections; and compare numbers
- **Operations and Algebraic Thinking:** understanding addition as put together; adding to; understanding subtraction as taking apart; and taking from
- **Numbers and Operations in Base Ten:** foundations of place value, and work with numbers 11-19
- **Measurement and Data:** identify, describe, and compare measurable attributes; classify objects; and count the number of objects in each category
- **Geometry:** identify and describe shapes

The concepts of *counting* and *cardinality* in Kindergarten are extended from previous learning in the Ohio Early Learning Standards for Mathematics. Meanwhile, new mathematical topics such as Operations and Algebraic Thinking, Numbers and Operations in Base Ten, Measurement and Data, and Geometry are introduced. These topics are further explored and extended in Grades 1-5.

Kindergarten Critical Areas of Focus (What Students Learn)

In kindergarten, emphasis is on the development of conceptual understanding through mathematical play. Students should leave kindergarten having experienced number play through 100. These experiences, to name a few, should include patterns of base ten, decade patterns, and the use of number words such as before/after and less/more. Students will gradually develop and strengthen computational skills through multiple opportunities to subitize numbers. As foundational skills develop with repeated and consistent opportunities to explore and learn conceptually, memorization is not appropriate or necessary. Through mathematical play, students will recognize the structure and patterns needed to count to 100 and build the basis for place value used in later grades.

Critical Areas of Focus

Ohio's Learning Standards for Mathematics include critical areas for instruction in the introduction to each grade, kindergarten through grade 8. The critical areas are designed to bring focus to the standards at each grade by describing the big ideas that educators can use to build their curriculum and to guide instruction.

In kindergarten, instruction should focus on two critical areas.

- Representing and comparing whole numbers, initially with sets of objects.
- Describing shapes and space.

Critical Area 1: Representing, relating, and operating on whole numbers, initially with sets of objects

Students use numbers, including written numerals, to represent quantities and to solve quantitative problems, such as counting objects in a set; counting out a given number of objects; comparing sets or numerals; and modeling simple joining and separating situations with sets of objects, or eventually with equations such as $5 + 2 = 7$ and $7 - 2 = 5$. (Kindergarten students should see addition and subtraction equations, and student writing of equations in kindergarten is encouraged, but it is not required.) Students choose, combine, and apply effective strategies for answering quantitative questions, including quickly recognizing the cardinalities of small sets of objects, counting and producing sets of given sizes, counting the number of objects in combined sets, or counting the number of objects that remain in a set after some are taken away.

Critical Area 1: Connections to the Early Learning Standards for Mathematics

- Count to 20 by ones with increasing accuracy (Number Sense: Number Sense and Counting)
- Identify and name numerals 1-9 (Number Sense: Number Sense and Counting)
- Demonstrate one-to-one correspondence when counting objects up to 10 (Number Sense: Number Sense and Counting)
- Understand that the last number spoken tells the number of objects counted (Number Sense: Number Sense and Counting)

- Identify whether the number of objects in one group is greater than, less than or equal to the number of objects in another group up to 10(Number Sense: Number Sense and Counting)
- Count to solve simple addition and subtraction problems with totals smaller than 10, using concrete objects (Number Relationships and Operations: Number Relationships)
- Identify without counting small quantities of up to 3 items (Subitize) (Number Sense: Number Sense and Counting)
- Order objects by measurable attribute (e.g., biggest to smallest, etc. (Measurement and Data: Describe and Compare Measurable Attributes)
- Sort and classify objects by one or more attributes (e.g., size, number) (Algebra: Group and Categorize)

Critical Area 2: Describing shapes and space.

Students describe their physical world using geometric ideas, e.g., shape, orientation, spatial relations, and vocabulary. They identify, name, and describe basic two-dimensional shapes, such as squares, triangles, circles, rectangles, and hexagons, presented in a variety of ways, e.g., with different sizes and orientations, as well as three-dimensional shapes such as cubes, cones, cylinders, and spheres. They use basic shapes and spatial reasoning to model objects in their environment and to construct more complex shapes.

Critical Area 2: Connections to the Early Learning Standards for Mathematics

- Describe and compare objects using measurable attributes (e.g., length, size, capacity, and weight) (Measurement and Data: Describe and Compare
- Demonstrate understanding of the relative position of objects using terms such as in/on/under/up/down, inside/outside, above/below, beside/between, in front of/behind, and next to. (Geometry: Spatial Relationships)
- Understand and use names of shapes when identifying objects. (Geometry: Identify and Describe Shapes)
- Name three-dimensional objects using informal, descriptive vocabulary (e.g., “cube” for box, “ice cream cone” for cone, “ball” for sphere, etc.). (Geometry: Identify and Describe Shapes)
- Compare two-dimensional shapes, in different sizes and orientations, using informal language. (Geometry: Analyze, Compare, and Create Shapes)
- Create shapes during play by building, drawing, etc. (Geometry: Analyze, Compare and Create Shapes)
- Combine simple shapes to form larger shapes. (Geometry: Analyze, Compare, and Create Shapes)

Examples of Mathematical Learning and Development in Kindergarten

Instructional Activities to Support Learning in Counting and Cardinality

Counting and Cardinality - Students enter Kindergarten with a broad range of experiences with numbers. Some students may already be able to rote count from 1 to 100. At the same time, other students may have limited experience with numbers up to 10.[1]

- **Daily Counting** - Establish daily counting routines: Counting by 1's and/or 10's starting at 1. Counting by 1's and/or 10's starting at another number. Counting down from 10.
- **Counting Around the Circle/Room**- Select a starting number in a counting sequence and have students count in order as each student around the circle/room says the next number in the sequence aloud.
- **Choral Counting**- Select a starting number in a counting sequence other than 1 and have all students count the next number in the sequence aloud together.
- **Starting and Stopping Counting**- Select a starting number in a counting sequence other than 1 and have students count aloud together up to a designated stopping point in the counting sequence up to 100.
- **Number Line**- Create a number line that you can add values to throughout the year as students deepen their understanding of the counting sequence.
- **Calendar Counting**- Use the calendar for the current month to have students count aloud to the current day of the month and write the corresponding numeral up to 20. (Try a linear calendar as well!)
- **School Days Counting**- Use the school calendar to count aloud up to the current instructional day number in the school year for the first 100 days.
- **Counting Objects**- Practice counting a variety of objects up to 20 objects around the room. Example: Shoes, pencils, books, blocks, buttons, shells, rocks, etc. Touch each object when counting out loud.
- **Roll and Count**- Roll dice (one or two), count the dots, and say the number. Write the corresponding numeral.
- **Teddy Bear Scatter**- Use various-sized small cups to scoop and scatter teddy bear counters. Count and write the total number of teddy bears up to 20.
- **Uno Card Counting**- Draw an Uno card and count out corresponding objects (buttons, beads, pennies, stones, etc.) to match the number.
- **Stacking Cups**- Use plastic cups to stack in pyramid formation to 20. Students stack and count out loud. If the cups fall, start again! Use a variety of sizes and colors. Optional Extension: Write numbers 1-100 on the cups, and students stack the cups in order.
- **Collection Count and Compare**- Use a small cup to scoop a collection of two items to 10 objects and scatter each of the items on small mats. Example: pennies and pom-poms or erasers and counters. Count and compare each collection to find the most/least.
- **Roll, Count and Compare**- Roll dice, count the dots, and decide which is more/less. If working in pairs, tally to find out who rolled the most.

- **Crocodile Chomp**- Project two numbers (or a group of objects to 10) on the Smart Board. Students use their arms to make a crocodile mouth to "chomp" the greater number. (This would be a great whole group activity!)
- **Linking Cube Towers**- Each pair of students draws a number card. Use linking cubes to build the number up to 10 cubes. Decide who has more.
- **Bracelet Building**- Use plastic pony beads and pipe cleaners to count out and build bracelets. Compare 2 bracelets to decide which one has more beads.
- **Uno Card Comparison**- Each pair of students draws an Uno card. Use counters to make the corresponding number. Decide which number is larger. The student with the larger number keeps the cards.
- **Ten Frame Fun**- Draw a number card (1-10) and build it with counters on a ten frame. Write the number.

Instructional Activities to Support Learning in Operations and Algebraic Thinking

Operations and Algebraic Thinking - Students build upon their understanding of counting and cardinality as they begin to develop meaning for addition and subtraction. Addition and subtraction in Kindergarten are done through modeling and representing problem situations using concrete and/or pictorial representations.[1]

- **Domino Addition-** Draw a domino and count the dots to 10. Write the corresponding addition problem on a dry-erase board. Show it another way. *For example:* Using objects, fingers, mental images, drawings, sounds such as claps, acting out situations, verbal explanations, expressions, or equations.
- **Roll and Add-** Roll two dice and write the corresponding addition problem to 10. If working in pairs, each student rolls one die. Then, work together to show the problem another way.
- **Pop-It Addition and Subtraction-** Write addition or subtraction problems on note cards/index cards, and students can use the Pop-It bubbles to work out the answer together. *For example:* If the card says $2 + 3 = \square$, have one student push down 2 bubbles, the other student push down 3, and then figure out the answer together. To practice subtraction, have one student press down all the bubbles, and the other "un-pop" the amount to be subtracted and see what is left.
- **Addition and Subtraction War-** A pair of students will flip two cards over and add them together. The student with the highest card keeps both. For subtraction, flip two cards and subtract. The student with the lowest number keeps the cards. Whoever collects the most cards by the end of the game wins!
- **Subtraction Smash-** Students will read a subtraction card and then use playdough to make small balls. *For example:* If the problem is $4 - 2 = \square$, they will form 4 small balls out of the dough and then smash 2 balls to represent the subtraction problem. Count how many balls are left to find the answer.
- **Subtraction Songs-** Students sing along and draw picture stories of different songs. *For example:* "Five Little Speckled Frogs", "No More Monkeys Jumping on the Bed!",

and “Five Little Ducks.” Pause the song throughout and ask, “4 little monkeys were jumping on the bed, and one fell off. How many monkeys are left?”

- **Number Bonds-** Students draw three circles in triangle formation (one circle at the top and two at the bottom) and a number card 1-10. Place the card in the top circle. Count out objects (cubes, pennies, pom-poms, etc.) equal to the number card. Now, break 10 objects apart into two other circles to make a number bond. How many ways can they make and break ten? Write addition or subtraction problems on a dry-erase board.

Instructional Activities to Support Learning in Numbers and Operations in Base Ten

Number and Operations in Base Ten - Kindergartners begin to develop an understanding of the Base 10 system. Students focus on the number 10 and make connections to the meaning of numbers from 11 to 19. For example, they are introduced to the number 10 as also being 10 ones and the number 11 as 10 ones and one more.[1]

- **Sticker Count-** Students draw a number card 11-19. Count out corresponding stickers and place them on a large piece of construction paper. Draw a circle around 10 stickers and practice counting on from 10. *For example:* If there are 14 stickers, students say, “10, 11, 12, 13, 14.” (Could also use small counters, pennies, pom-poms, etc.)
- **Popsicle Stick Bundles-** Students draw a number card 11-19. Count out corresponding popsicle sticks and bundle a group of 10. *For example:* If the number is 12, students bundle 10 sticks with a rubber band and leave 2 sticks out. Practice counting on from 10 and then write the number.
- **Heads and Tails-** Shake a group of pennies (11-19) together and drop them on a mat. Separate into groups of heads and tails. Write the addition problem to represent the total number of pennies. *Optional Extension:* Create number bonds with pennies. Separate the total number of pennies in two parts (heads and tails). Write the total number of pennies at the top of the number bond and corresponding parts below.
- **Double Ten Frame Fun-** Draw a number card (11-19) and build it with counters and a double ten frame. Write the number.
- **Tricky Teens Paper Chain-** Compose a paper chain addition problem for (11-19) using two different colors of paper to represent the number. *For example:* 10 + 1= 11, 10+2=12, and so on. Hang the paper chains in the classroom.

Instructional Activities to Support Learning in Measurement and Data

Measurement and Data - Kindergartners further develop an understanding of what can be measured and how to measure it. Kindergartners learn to describe measurable attributes of objects such as length, weight, and height. Students also compare objects and verbally describe the measurable attributes.[1]

- **Measuring Cubes-** Measure a variety of objects around the room (pencil, book, easel, cubby, etc.) using measuring cubes. Decide which object is the shortest/longest.
- **String Sorting-** Sort colorful string into three boxes: short, medium, and long. *Optional Extension*- Sort other items like sticks, leaves, and pencils in this way. Compare sizes.

- **Kid Comparison-** Sort and compare students in a variety of ways. *For example:* long hair or short hair, light hair or dark hair, packing lunch or buying lunch, bus rider or car rider, etc.
- **Math Hike-** Take a hike around the school and collect a variety of natural materials: sticks, vines, pinecones, leaves, etc. Explore and sort the materials by attribute. *Optional Extension:* Measure the natural materials using paper clips.
- **This is Bigger Than That-** Students share a "bigger than" statement. *For example:* "An elephant is bigger than a mouse." Draw a silly picture to represent each statement. Display drawings in the classroom.
- **Apple Tasting-** Sort a variety of apples by color (red, green, yellow). Encourage students to taste each apple and use corresponding color cubes to "vote" for their favorite. Make a class graph together.
- **Book Baskets-** Sort and classify classroom picture books using a variety of categories. *Example:* animals, alphabet, rhyming, graphic novels, seasonal, etc. Create classroom book baskets for easy access.
- **Object Sort-** Sort classroom objects in a variety of ways. *For example:* Sort by shape, color, texture, etc. Count the number of objects in each category to ten.
- **Alphabet Sort-** Sort and classify alphabet letters in a variety of ways using magnetic letters. *Example:* Capital and lowercase letters or curvy and straight letters.
- **Shoe Sort-** Sort and classify shoes in a variety of ways. *For example:* sneakers, sandals, Velcro, laces, etc.

Instructional Activities to Support Learning in Geometry

Geometry - Kindergarten children can recognize and imagine shapes in their surroundings. They identify, name, and describe basic shapes such as squares, triangles, circles, rectangles, hexagons, cubes, cones, cylinders, and spheres, which appear in a variety of ways at different sizes and orientations. [1]

- **Tracing Shapes-** Trace the flat face of common 3-dimensional classroom objects. *Example:* pencil case, water bottle, book basket, book, etc. Notice the 2-dimensional shape outline left behind. Color and label each shape. *Optional Extension:* Cut out and organize like shapes together with classmates.
- **Shape Hunt-** Take a walk around the school building (or outside). Record how many different shapes you can find in the environment. *For example:* Windows, stairs, doorknob, exit sign, clock, etc. Draw a picture of your favorite shape. *Optional Extension:* Create a class map/mural by cutting out the environmental shapes and placing them where they belong.
- **Shape Building-** Use a variety of interesting materials to build shapes. *For example:* playdough, sticks, toothpicks, small boxes, pieces of cardboard or cloth, etc.
- **Shape Description-** One partner draws a shape card and describes the shape using verbal cues while the other partner tries to draw the shape. *For example:* "Start at the top of the paper and curve to the right. Curve down, around, and all the way back up." (circle)
- **Guess the Shape-** Pass a bag of small shapes around the circle. One student reaches in and tries to guess the shape without looking. Try describing the shape and

corresponding attributes to a classmate to see if they can guess. *For example:* "This shape has three straight, equal sides. What is it?" (triangle)

Books that Promote Mathematical Thinking

The following list of books addresses grade-level-appropriate mathematics topics. These can be checked out from the local community or school libraries. They offer early literacy opportunities for students while integrating mathematics.

Counting and Cardinality

Anno's Counting Book by Anno Mitsumasa
10 Black Dots by Donald Crews
12 Ways to Get 11 by Eve Merriam
Chicka Chicka 123 by Bill Martin Jr.
City by Numbers by Stephen Johnson
Feast for 10 by Cathryn Fallwell
Fish Eyes: A Book You Can Count On by Lois Elhert
How do Dinosaurs Count to Ten by Jane Yolen
I Know Numbers by Taro Gomi
On the Launch Pad: A Counting Book About Rockets by Michael Dahl
Olivia Counts by Ian Falconer
Zero is the Leaves on the Trees by Betsy Franco

Number and Operations

100 Snowmen by Jen Arena
Bunny Money by Rosemary Wells
Chicka Chicka 123 by Bill Martin Jr.
The Chicken Problem by Jennifer Oxley
Elevator Magic by Stweart Murphy
Frank and Lucky Get Schooled by Lynne Rae Perkins
Numbers by John J. Reiss
Numbers Everywhere by Elliott Kaufman
Pigeon Math by Asia Citro
Place Value by David Adler
The Power of 10 by Judy Newhoff and Deanna Ruby Zevin

Operations and Algebraic Thinking

100 Hungry Ants by Elinor J Pinczes
The Doorbell Rang by Pat Hutchins
Equal Shmequal by Virginia Kroll
I Know an Old Lady Who Swallowed a Fly by Mary Ann Holberman
The Great Graph Contest by Loreen Leedy
Mystery Math: A First Book of Algebra by David Adler
Lia and Luis Who Has More by Ana Crespo
The Napping House by Audrey Wood
A Remainder of One by Elinor J. Pinczes
Rooster's Off to See the World by Eric Carle
Spaghetti and Meatballs for All: A Mathematical Story by Marilyn Burns
You Were a Plus Sign by Trisha Speed Shackan

Geometry and Measurement

Alma's Art by Roda Ahmed
The Greedy Triangle by Marilyn Burns
If You Were a Quadrilateral by Molly Blaisdell
*Inch by Inch b*y Leo Leoni
Measuring Penny by Loreen Leedy
Mouse Shapes by Ellen Stoll Walsh
Round is a Tortilla by Roseanne Thong
Sorting by Henry Pluckrose
Swirl by Swirl by Joyce Sidman
Tangled: A Story About Shapes by Anne Miranda
When a Line Bends… A Shape Begins by Rhonda Gowler Greene

Additional Content/Informational Resources

- Kindergarten Mathematics Standards - Provide learning outcomes for the end of the Kindergarten academic year.
- Kindergarten Model Curriculum – Provides content elaborations for the grade level standards and the expectations for learning for all students.
- Kindergarten Standards for Mathematical Practice – These describe the skills that mathematics educators should seek to develop in their students.
- Color Coded K-5 Learning Progressions – Identifies the learning progression of mathematical content across K-5.
- Achieve the Core - These guides will help educators understand and implement the mathematics standards. They can use the guides as they observe teachers giving instruction and provide them with feedback that supports their planning and reflection.
- K - 8 Content Emphases
- K - 8 Instructional Practice Guide
- Arizona Progressions - These narrative documents by the University of Arizona describe the typical learning progression of a topic, informed by both research on children's cognitive development and the logical structure of mathematics.
- Illustrative Mathematics – Showcases the range and types of mathematical work that students should experience as teachers use Ohio's Learning Standards in Mathematics. It also presents other tools supporting standards-based instruction.
- Progression Videos of "How" students build math knowledge

Instructional Resources

- Erikson Institute Early Math Collaborative - Developmentally aligned information and instructional activities.
- Teaching Channel - Provides guiding questions to use during planning and instruction. Classroom videos model best practices. Learning activities showcase rigorous problems that deepen conceptual understanding.
- YouCubed – Showcases research-based teaching methods, mathematics tasks, videos, and ideas on how to bring about high levels of student engagement.
- National Library of Virtual Manipulatives - The site contains manipulatives and concept tutorials across the grade bands.
- Learning Trajectories – Discover how children develop their mathematical thinking and learning skills.
- Inside Mathematics - Educators can find exemplary standards-based lesson ideas, as well as classroom videos. Teachers interested in the lessons can search under "performance task" for lesson ideas organized by grade and course.
- Illuminations - This project by the National Council of Teachers of Mathematics provides quality lessons and interactive resources for teaching and learning mathematics.

- Resources for 3-Act Math Class (Choose appropriateness for your grade level. These are tasks that foster mathematical modeling.)

Dan Meyer	Graham Fletcher	Robert Kaplinsky
Andrew Stadel	John Stevens	Michael Fenton
Geoff Krall	Jon Orr	Kyle Pearce

- Steve Wyborney -Contains popular instructional activities such as Splat, Hundred Maze, Subitizing, Fraction Splat, Primary Tile, Tile Area, and Esti mystery.
- MCTM Collection of Cognitively Demanding Tasks – A collection of resources for finding those rich multidimensional math tasks.
- Number Talks-provide video resources about how to engage students in mathematical conversation using mental math to solve problems.
- Building Number Sense (Jo Boaler, Ruth Parker, Sherry Parrish)
- Inside Mathematics Number Talks
- Visual Patterns - great site for students to think algebraically and build expressions to model the world with mathematics.
- Clothesline Math – Mathematical tasks using a clothesline as an interactive number line.
- Which One Does Not Belong- Contains many low-floor and high-ceiling tasks. These are excellent for getting all students to contribute during mathematical discourse.

References

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., et al. (2007). School readiness and later achievement. *Developmental Psychology, 43*(6), 1428–1446. https://doi.org/10.1037/0012-1649.43.6.1428

[1]Gojak, Linda M., and Ruth Harbin Miles. *The Common Core Mathematics Companion the Standards Decoded, Grades K-2; What They Say, What They Mean, How to Teach Them*, Corwin Mathematics, Thousand Oaks, CA, 2015, pp. 2, 22, 74, 120, 164.

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