# Grade Pre- K Mathematics

## Mathematics Background for Grade Pre- K Teachers

### Algebraic Reasoning: Patterns and Functions

Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

**Central Understanding:** Patterns are found in our environment.
**Background:** Repetitive patterns contain recognizable core elements that are repeated. These patterns can be represented in more than one way. Patterns are found in many physical and geometric situations in a child's environment as well as in number. Identification of patterns is a basic building block for algebraic thinking. Children make predictions and generalizations in their informal pattern explorations. As these generalizations are investigated, they help build a foundation for both number and geometry.

### Numerical and Proportional Reasoning

Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technologies.

**Central Understanding:** Our environment can be described in a quantitative way using number concepts.
**Background:** Number concepts are intimately tied to the world around us. Recognizing and applying number relationships in our environment is the foundation of making sense of the world in a mathematical way (van de Walle, p.115). Determining and comparing quantities enables children to form ideas about number and develop number sense. Counting is the determination of the total number of objects in a set and requires much more than the recitation of words in a correct sequence. Counting is a foundation for children's early work with number, patterns and sets.

### Geometry and Measurement

Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools and technologies.

**Central Understanding:** The attributes of objects in the environment can be measured.
**Background:** Children can identify and describe attributes of objects in their environment. Similarities and differences of objects can be explained based on color, orientation, texture and measurable attributes such as size, shape, weight or length. Opportunities for direct comparisons of measurable attributes help children solve problems such as categorizing objects that are the same as, longer than or heavier than another object. Spatial sense can be defined as an intuition about shapes and the relationships among shapes (van de Walle p.347). Children develop spatial sense when they have opportunities to observe, feel, build, describe and take apart two- and three-dimensional shapes and solids.

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## Working with Data: Probability and Statistics

Data can be analyzed to make informed decisions using a variety of strategies, tools and technologies.

**Central Understanding:** Objects in the environment can be organized based on attributes and spatial relationships.
**Background:** The ability to observe, identify, qualify and quantify attributes develops the foundation for classification and data analysis. Comparisons of quantity, physical attributes, spatial relationships and use of objects provide structure for the analysis of various ways that things can be categorized.

Source: Model for Mathematics Curriculum, CSDE 2008

**Overview:**
This curriculum is aligned to the 2005 Connecticut Mathematics Curriculum Frameworks and references the CMT 4th. Generation.

Grade level expectations (GLEs) are coded (see below). For each GLE, or group of GLEs, activities are listed that are specific to those expectations.

**Assessment:**

**Vocabulary:**
A list of important mathematical vocabulary can be found at the end of each unit. Students need to hear these words modeled so that they can communicate effectively in mathematics. Words need to be associated with visual representations and connected to students' lives.

**Pacing Guide:** Refer to the pacing guide for a sequence of units of study and activities.

**Terms to help with pacing and planning:**
The following terms are included in this curriculum guide to help teachers with their planning and pacing:
**Explore:** a topic which is not formally taught. For example, when kindergarteners use tiles to cover a desk, they are exploring the concept of area. They will not be asked for a definition of area nor will they be assessed on the topic.
**Introduce:** a skill which is presented by the teacher and students practice, but are not expected to master.
**Master**: a topic that most students are expected to know and understand, based on chronological and developmental levels. The topic has been introduced previously, practiced and students are able to apply the concept or skill 80% of the time.
**Extend:** activities that take students more deeply into a topic.

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**Key to Coding:**

This curriculum is based on the 2005 Mathematics Curriculum Framework and the 2007 Grade Level Expectations (which were written to further clarify what students should know and be able to do at each grade level.)
There are 4 content standards. Each includes two or three component statements.

Algebraic Reasoning: Patterns and Functions
- 1.1 Students should understand and describe patterns and functional relationships
- 1.2 Students should represent and analyze quantitative relationships in a variety of ways
- 1.3 Students should use operations, properties and algebraic symbols to determine equivalence and solve problems

Numerical and Proportional Reasoning
- 2.1 Students should understand that a variety of numerical representations can be used to describe quantitative relationships
- 2.2 Students should use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities

Geometry and Measurement
- 3.1 Students should use properties and characteristics of two- and three-dimensional shapes and geometric theorems to describe relationships, communicate ideas and solve problems
- 3.2 Students should use spatial reasoning, location and geometric relationships to solve problems
- 3.3 Students should develop and apply units, systems, formulas and appropriate tools to estimate and measure

Working with Data: Probability and Statistics.
- 4.1 Students should collect. organize and display data using appropriate statistical and graphical methods
- 4.2 Students should analyze data sets to form hypotheses and make predications
- 4.3 Students should understand and apply basic concepts of probability

These component statements are further delineated in the Grade Level Expectations document. (See Appendix A).
Therefore, a statement coded 4.1.2 refers to collecting, organizing and displaying data. The .2 refers to the grade level expectation and will describe specific graphs that will be used**.**

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**Unit Focus: Sorting and Shapes** **Pacing: FALL**
In this unit, students describe characteristics of objects and sort according to size, shape and color. They also recognize and compare shapes.

**Grade level expectations:** The student will be able to:

1.1.1 **Sort and classify familiar objects by a single attribute (size, shape, color, texture, orientation and position) and explain the reason.**

**3.1.1 Identify and describe familiar shapes (triangles, squares, rectangles and circles) and solids (cubes, spheres, cylinders and prisms) in the environment and contextual situations.**

3.1.2 Compare and sort familiar shapes and solids in the environment and contextual situations.

3.1.3 Construct shapes using a variety of materials.

**3.2.4 Describe location, direction, and position of objects using terms such as under, over, inside, next to, near, in front of, first and last.**

3.2.5 Complete simple shape and jigsaw puzzles and explain the reasoning used to complete the puzzle

**Literature connection – Big Books**
*New Shoes, Red Shoes* by Susan Rollings
*I Love Trucks by*
*It's Snack Time* by Jenny Penna

**Activities*:***
1. Using a set of concrete objects, students identify and describe the attribute of color, shape and size MC 1-1, 1-2, 1-3

2. Students use one-to-one correspondence to compare sets of objects using more than, less than or same as. MC 1-4

3. Students compare objects and explain how they are alike and different. MC 2-1

4. Students begin to sort objects by like attributes and explain the sorting rule. MC 2-2, 2-3

5. Students will use the terms above, below, in, out, in back, in front, on top, on bottom, in the middle, left, and right to describe the location or position of objects. MC 3-1, 3-2, 3-3, 3-4

6. Students will use the terms before and after, first and last to describe the position of objects arranged in a row. MC 3-6

7. Students identify and compare 3D shapes in the environment. MC 4-1, 4-2

8. Students identify and compare 2D shapes. MC 4-4, 4-5

*Additional activities*:

- Supply children with shapes and solids that have been presorted. Ask questions such as:
  Can you think of a reason these items are sorted this way?
  Could these items be sorted differently?
  How would you sort them?
- Provide opportunities to put together, take apart, make and build shapes and solids out of materials such as clay, blocks or paper.
- Provide children with opportunities to complete simple shape (e.g., animals, numbers or letters) and jigsaw puzzles.
- Have children put three-dimensional objects in place based on their shape (such as placing round pegs in round holes or using a Shape Sorter). Have the children share how they where a shape will fit.

**Assessment:**

**VOCABULARY:** above, after**,** attribute, alike, back, before, below, bottom, circle, color, cone, cube, cylinder, different, first, front, group, in, last, left, less than, long, middle, more than, out, rectangle, right, same as, size, shape, short, sort, sphere, square, thick, thin, top, triangle.

**Electronic Resources:**

- National Library of Virtual Manipulatives http://nlvm.usu.edu/en/nav/grade_g_1.html interactive online manipulatives listed by grade and topic
- I've Seen That Shape Before: http://illuminations.nctm.org/LessonDetail.aspx?id=L237 Students learn the names of solid geometric shapes and explore their properties.

**Unit Focus: Patterns and Numbers to 20** **Pacing**: **WINTER**
In this unit, students identify, describe, copy, extend and create pattern. They also count and compare numbers 0-20.

**Grade level expectations:** The student will be able to:

1.1.2 **Recognize copy, extend and create simple AB patterns using objects, movement or sounds.**

2.1.1 Represent quantities of up to 20 objects in a set.

**2.1.2 Compare two sets of up to 20 objects, and identify which set is more, less or the same.**

2.1.3 Identify the ordinal position of objects: first and last.

2.1.4 Explore a whole and half of an object.

**2.2.5 Count by rote to at least 20.**

2.2.6 Count as one more object is added to a set of up to 20 objects.

2.2.7 Act out and solve story problems using sets of up to 10 objects.

**Literature connection – Big Books**
*Count the Baby Animals* by Bill Fergusan
*What Could Come Next?* by David Whiting
*Water for One, Water for Everyone* by Steven Swinburne
*A Day in the Park* by Becky Harr

**Activities:**
1. Students recognize, copy, extend, and create repeating patterns using movement, sounds and objects. MC 6-1, 6-2, 6-3, 6-4, 6-5
*Additional activity:*
   - Show children a group of objects arranged in a teacher-made AB pattern. Have the children describe the pattern and then copy the pattern using the same objects.

2. Students use one-to-one correspondence to determine how many objects are in a set of up to 5 objects. MC 5-1

3. Students count and recognize sets of up to 5 objects. MC 5-1, 5-2, 5-3

4. Students use zero to represent a set of nothing. MC 5-4

5. Students use ordinal numbers to describe position in objects arranged in a line. MC 5-6

6. Students use one-to-one correspondence and rote counting to count sets of up to ten objects. MC 7-1, 7-2, 7-3, 7-4
**Teacher note:** extend all activities above to include numbers to 20.

7. Students act out and solve story problems using sets of up to 10 objects.
*Additional activities:*

- Have children use their bodies and movements such as clapping, hopping or nodding or moving to music to demonstrate quantities 2, 3… 20.

8. Students explore a whole and half of an object.
**Teacher notes:**

- During normal classroom activities, divide whole objects such as fruit, a cracker, a paper plate or a piece of drawing paper into two parts and ask the children if the parts are the same, equal (one-half) or unequal.
- Using Velcro foods (Melissa and Doug) have students cut items in half to show two equal pieces.

**Assessment:**

**Electronic Resources:**

- Kinderplans.com http://www.kinderplans.com/content.cfm?pageid=132 Printable Math Activities for Kindergarten and Preschool
- Center for Distance and Online Learning http://teams.lacoe.edu/teachers/index.asp source of lesson plans for all areas of math, also includes links to other math sites.
- Gayle's Preschool Rainbow http://www.preschoolrainbow.org/counting-theme.htm Early childhood education ideas and activities that encourage counting, observation and listening skills.
- Internet4Classrooms http://www.internet4classrooms.com/kplus_subjects.htm a free web portal designed to assist teachers in finding high-quality, free Internet resources to use in classroom instruction, developing project ideas, and reinforcing specific subject matter.
- Let's Count to 5: http://illuminations.nctm.org/LessonDetail.aspx?id=U57 In this unit, students make groups of zero through five objects and connect number words to the groups. They use numerals to record the size of a group.
- Building numbers to 10: http://illuminations.nctm.org/LessonDetail.aspx?id=U147 In this unit, students make groups of zero to 10 objects, connect number names to the groups, compose and decompose numbers, and use numerals to record the size of a group.
- Understanding a Child's Development of Number Sense: http://illuminations.nctm.org/Reflections_preK-2.html (text and video)

**UNIT 2 VOCABULARY:** count, first, last, less, more, number, pattern, second.

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**Unit Focus: Data and Measurement** **Pacing: SPRING**
In this unit, students collect, record and graph data. Using non-standard units, they measure and compare length, area, and capacity.

**Grade level expectations:** The student will be able to:

3.3.6 Use patterns to determine events that reoccur.

3.3.7 Sequence events and describe time periods using terms such as morning, afternoon, night, yesterday, today and tomorrow .

**3.3.8 Use nonstandard units or reference objects to compare length, area and capacity and to order, estimate and sort objects by size (length or area). Describe the comparisons using language such as more, longer, shorter or taller.**

3.3.9 Discuss strategies to estimate and compare length, area, temperature and weight.

4.1.1 Create real graphs using familiar objects and pictures that represent information about the group of children.

**4.2.2 Describe real graphs using comparative language such as more, less, most, least and the same.**

4.3.3 Use patterns to describe some events that repeat.

4.3.4 Explain why events are likely or unlikely to happen, based on personal experiences.

**Literature connection – Big Books**
*Help Sam Build* by Pat Cella
*Our Favorite Things* by Becky Manfredini

**MEASUREMENT Activities:**

1. Students compare objects by length and weight. MC 8-1, 8-2

2. Students order three or more objects by length and height. MC 8-3
*Additional activity*:
Cut heavy paper or cardboard into strips that are 2 inches wide. Have each child place his or her foot at one end of the strip. Cut a strip to match the length of the child's foot. Choose one child's strip as a reference and ask the other children to state whether their strip is the same as, longer than or shorter than the strip that was chosen. To help children determine the relative length of their strip, have them place their strip next to the strip that was chosen. Once each child has decided whether his or her strip is the same as, longer, or shorter, have the children discuss their observations. Ask questions such as: How did you decide to describe your strip? How does your strip compare to another child's who described her foot the same way? Record each child's name and the date on his or her strips. These strips can be used to make a class graph. The same strips can be used later in the year to compare the changes, if any, in foot lengths.

3. Students compare capacity. MC 8-4
*Additional activity:*
Put out a tub of rice and a variety of containers so that children can explore filling the containers and comparing the amount of rice each container holds. Discuss with the children what they observed about the different containers and their capacity.

4. Students measure area by covering. MC 8-5
*Additional activity:*
Give each child a rectangular piece of paper. Have the child think about how many scoops or handfuls of a designated object such as counters, beans, buttons or pasta it will take to cover the paper. Allow the children to check their thinking and repeat the activity until the paper is covered. Discuss why changes were or were not made in order to cover the paper.

5. Students order events according to the time of day they occur. MC 8-6

**DATA Activities:**
1. Students collect data, construct real graphs, then construct a picture graph to compare and interpret data. MC 9-1, 9-2, 9-3

**Assessment:**

**Electronic resources:**
- Mr. Roger's Sorting & Classifying: http://pbskids.org/rogers/parentsteachers/theme/1461_p_act.html. In this activity, students play different sorting games using a deck of cards.

**UNIT 3 VOCABULARY** after, afternoon, before, big, covers more, covers less, evening, heavy, holds more, holds less, length, light, long, same, short, small, tall, weight.