Mathematics: Pre-Kindergarten Through Grade 8

Mathematics Content Strands

M1 Numbers and Operations

Number pervades all areas of mathematics. The other four Content Standards as well as all five Process Standards are grounded in understanding number. Central to this standard is the development of number sense, which allows students to naturally combine or decompose numbers, solve problems using the relationships among operations and knowledge of the base-ten system, and make a reasonable estimate for the answer to a problem.

Computational fluency – having and using efficient and accurate methods for computing – is essential. Students should be able to perform computations in different ways, including mental calculations, estimation, and paper-and-pencil calculations using mathematically sound algorithms. All students should use calculators at appropriate times, setting the calculator aside when the instructional focus is on developing computational algorithms.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:
- understand numbers, ways of representing numbers, relationships among numbers and number systems;
- understand meanings of operations and how they relate to one another;
- understand how to compute fluently and make reasonable estimates.

M2 Algebra

The ideas of algebra are a major component of the school mathematics curriculum and help to unify it. Mathematical investigations and discussions of arithmetic and its properties frequently include aspects of algebraic reasoning. Such experiences present rich contexts and opportunities for enhancing mathematical understanding and are an important precursor to the more formalized study of algebra in the middle and secondary grades. A strong foundation in algebra should be in place by the end of the eighth grade, and all high school students should pursue ambitious goals in algebra.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:
- understand patterns, relations, and functions;
- represent and analyze mathematical situations and structures using algebraic symbols;
- use mathematical models to represent and understand quantitative relationships;
- analyze change in various contexts.

M3 Geometry

Geometry and spatial sense are fundamental components of mathematics learning. They offer ways to interpret and reflect on our physical environment and can serve as tools for the study of other topics in mathematics and science. Geometry is a natural area of mathematics for the development of students' reasoning and justification skills that build across the grades.
Geometry should be learned using concrete models, drawings, and dynamic software. As the study of the relationships among shapes and their properties becomes more abstract, students should come to understand the role of definitions and theorems and be able to construct their own proofs.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:
- analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships;
- specify locations and describe spatial relationships using coordinate geometry and other representational systems;
- apply transformations and use symmetry to analyze mathematical situations;
- use visualization, spatial reasoning, and geometric modeling to solve problems.

M4 Measurement

The study of measurement is crucial in the K-12 mathematics curriculum because of its practicality and pervasiveness in many aspects of everyday life. Measurement is possibly the area of mathematics that is most important when considering everyday applications of mathematics, and highlights connections between mathematics and areas outside of the school curriculum such as social studies, science, art, and physical education. The study of measurement helps students establish connections within mathematics and provides an opportunity for learning about and unifying ideas concerning number and operations, algebra, geometry, statistics, probability, and data analysis.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:
- understand measurable attributes of objects and the units, systems, and processes of measurement;
- apply appropriate techniques, tools, and formulas to determine measurements.

Data Analysis and Probability

To analyze data and reason statistically are essential to be an informed citizen, employee, and consumer. The amount of statistical information available to help make decisions in business, politics, research, and everyday life is staggering. Through experiences with the collection and analysis of data, students can learn to make sense of and interpret information and allow them to make appropriate arguments and recognize inappropriate arguments as well.

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:
- formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them;
- select and use appropriate statistical methods to analyze data;
- develop and evaluate inferences and predictions that are based on data;
- understand and apply basic concepts of probability.

Mathematics Process Standards

The DoDEA PK-12 mathematics program includes the process standards: problem solving, reasoning and proof, communication, connections, and representation. Instruction in mathematics must focus on process standards in conjunction with all PK-12 content standards throughout the grade levels.

Problem Solving	Reasoning and Proof	Communication	Connections	Representation
Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to: • build new mathematical knowledge through problem solving; • solve problems that arise in mathematics and in other contexts; • apply and adapt a variety of appropriate strategies to solve problems; • monitor and reflect on the process of mathematical problem solving.	**Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:** • recognize reasoning and proof as fundamental aspects of mathematics; • make and investigate mathematical conjectures; • develop and evaluate mathematical arguments and proofs; • select and use various types of reasoning and methods of proof.	**Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:** • organize and consolidate their mathematical thinking through communication; • communicate their mathematical thinking coherently and clearly to peers, teachers, and others; • analyze and evaluate the mathematical thinking and strategies of others; • use the language of mathematics to express mathematical ideas precisely.	**Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:** • recognize and use connections among mathematical ideas; • understand how mathematical ideas interconnect and build on one another to produce a coherent whole; • recognize and apply mathematics in contexts outside of mathematics.	**Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:** • create and use representations to organize, record, and communicate mathematical ideas; • select, apply, and translate among mathematical representations to solve problems; • use representations to model and interpret physical, social, and mathematical phenomena.

Strand:
Standards:

M1   **Numbers and Operations**
In Pre-Kindergarten, all students should:

PK.M.1a: recognize written numbers 0 to 10 and differentiate them from other symbols;

Example: Identify numbers in environmental print, e.g., road signs.

PK.M.1b: count in a sequence forward from one to ten;

Example: Take pencils from a box and count as you remove each pencil.

PK.M.1c: identify and name numerals from 0 to 10;

Example: Identify numbers using number cards, e.g., sandpaper, pudding, etc.

PK.M.1d: use one-to-one correspondence to construct sets with more, fewer, or the same number of objects than a given set;

Example: Construct sets of the same, more, or fewer items, e.g., use raisins, banana chips, and dried fruit to make trail mix.

PK.M.1e: compare the number of items in two sets using comparative language, i.e., more, fewer, same number;

Example: Compare and identify the number of blocks in each set with comparative language.

Strand:
Standards:

M2   **Algebra**
In Pre-Kindergarten, all students should:

PK.M.2a: sort, classify, and order objects by one attribute;

Example: Sort buttons into groups by size, number of holes, color, etc.

PK.M.2b: identify, copy, extend, and create simple patterns or patterns of sounds, shapes, and motions;

Example: Identify and copy patterns generated by the teacher, i.e., clap – clap – point. Student creates his/her own sound patterns.

PK.M.2c: identify and describe simple patterns in sets of objects;

Example: Using snap cubes create a tower that has a color pattern and describe the pattern you used.

PK.M.2d: identify a change in common objects, sounds, or movements;

Example: Start with blocks of four different colors. Students close their eyes, and one is removed. Ask students to identify change.

Strand:	**M3**	**Geometry**
Standards:		In Pre-Kindergarten, all students should:

PK.M3a: identify, describe using their own words, and create two-dimensional shapes, e.g. triangle, rectangle, circle;

Example: While playing "I Spy" determine the shape of an object.

PK.M.3b: identify and describe using their own words attributes of three-dimensional objects, e.g. cube, sphere;

Example: Describe attributes of a baseball and a box.

PK.M.3c: describe and demonstrate location and physical proximity, i.e., above, behind, beside etc.

Example: Choose three children and describe their positions relative to each other.

Strand:	**M4**	**Measurement**
Standards:		In Pre-Kindergarten, all students should:

PK.M.4a: describe everyday events in sequential order;

Example: Describe the routine for going to lunch, i.e., lining up, walking down hall, going through the lunch line, sitting, eating, etc.

PK.M.4b: identify the passage of time;

> **Example:**   Describe the sequence of events in the school day.

PK.M.4c: identify measurable attributes, e.g., length, capacity, weight, temperature;

> **Example:**   Using 12-inch string, children find items in the room that are the same size, longer, shorter.

PK.M.4d: use nonstandard measurements to measure attributes of length, height and weight;

> **Example**: Each child uses his/her hand to measure the height of a chair.

PK.M.4e: order a like set of objects according to a measurable attribute, e.g., length, thickness.

> **Example:**   Place five books in order from lightest to heaviest.

Strand: **M5**   **Data Analysis and Probability**
Standards: In Pre-Kindergarten, all students should:

PK.M.5a: sort, organize, and interpret data by similarities and differences.

> **Example:** Make a class graph about eye color and discuss results.