



Math Curriculum

Math Overview

The mathematics program at The Philadelphia School develops curious and disciplined mathematical thinkers who view mathematics as a body of knowledge, a language, and a way of making sense of the world. The program consists of a progression of math skills, concepts, and procedures that build in complexity from grade to grade.

Our teaching aligns with our core values: we approach mathematics from a relational, developmental, innovative, and constructivist perspective. Through whole-group and small-group investigations, students learn how to communicate their thinking and to make connections to real-world situations. At each grade level, students build critical thinking skills and conceptual understanding through authentic explorations in posing and solving problems that can be applied to situations beyond our classrooms. In this way, students strengthen their foundation for further mathematical thinking and learning, and they grow to recognize the power of systematic mathematical thinking across all disciplines.

Instead of racing to cover many topics in a "mile-wide, inch-deep curriculum," we provide a program that emphasizes depth of study. For example, as opposed to moving quickly to teach students traditional algorithms for converting fractions to decimals and ratios, Junior Unit students work to represent their ideal day with a pie chart, using various strategies to calculate, understand and represent equivalencies in different forms. This targeted focus helps students gain a solid understanding of concepts, a high degree of procedural skill and fluency, and the ability to apply the math they know to solve problems inside and outside the classroom.

Early Childhood

Throughout the early childhood years, we encourage children to notice and engage with the mathematical dimensions of their world. They explore patterns, investigate quantities, navigate spatial relations, and grapple with authentic, day-to-day problems such as building stable block structures or sharing harvested cherries from our garden fairly with classmates. Mathematics helps children make sense of their world, both in and outside of school.

Our early childhood classrooms are designed with intentionality to provide the materials, time, and teacher support for children to engage with, explore and manipulate mathematical ideas. During project work, children engage in rich math investigations and activities as a natural part of exploring high interest topics: for example, preschoolers learning about mice might measure out quantities to better understand and demonstrate how much a mouse eats each night, while kindergarteners might categorize and graph the types of bones discovered while dissecting an owl pellet during their project study on owls native to their outdoor classroom.

Through a combination of whole group, small group, and individual work, teachers support preschoolers as they grow in their ability to demonstrate one-to-one correspondence when counting, recognize and connect numerals to their corresponding quantities, identify shapes and patterns, and place objects in order, sequence, and category. In kindergarten, students are pushed to grow this mathematical understanding, as they begin to understand that quantities are composites of smaller units and can be composed and decomposed in a variety of ways, practice skip-counting and counting backwards, and represent numbers with written and spoken numerals. As preschoolers and kindergarteners work and play with patterns, numbers and concepts, they are becoming more confident and

creative mathematical thinkers, developing mathematical habits and dispositions that will support them throughout the grades.

Primary Unit - Third Grade

Through mini-lessons, small group explorations, partner games, and independent activities, Primary and third grade students deepen their conceptual understanding of mathematics and grow in flexibility with numbers, operations, measurement, and geometry. As children strengthen their foundational math skills, they develop mathematical habits and dispositions that will support them throughout the grades. This includes making sense of problems, using tools strategically, and being comfortable taking risks while learning to communicate mathematical reasoning. New concepts are introduced and explored using physical manipulatives, visual models, and authentic contexts. Children share their mathematical understandings in class discussions, and they learn to use pictorial representations and written notation to model, confirm, and adjust their thinking.

In the Primary Unit, first and second graders strengthen their understanding of addition, subtraction, and place value. Children practice thinking flexibly about numbers and the part-whole relationships within a given quantity. To encourage efficiency and accuracy, students try out and reflect on a variety of addition and subtraction strategies, and they use increasingly sophisticated strategies to solve problems. Primary students also focus on understanding whole number relationships of place value, including being able to count and represent items organized in groups of hundreds, tens, and ones using manipulatives, drawings, words, and number lines. Students strengthen their understanding of geometry, measurement, and data through games and hands-on, cross-disciplinary investigations. For example, during a science study of birds, students use tape measures to help classmates measure their “wingspans,” then they compare their measurements with each other’s and with the wingspans of local bird species. Throughout their math investigations, Primary students are working on persevering and learning from their mistakes as they become more confident and creative mathematical thinkers.

In third grade, students continue to build their accuracy, efficiency, and flexibility with addition and subtraction. Using an open number line, students explore the difference, removal, and missing addend models of subtraction, and they apply this understanding as they learn to construct and interpret timelines of important historical events in their thematic studies. Third graders also develop a foundational understanding of multiplication and division. Using pictorial representations of items arranged in equal groups or arrays, they explore the relationships between the four operations, and they use increasingly sophisticated strategies to solve multiplication and division problems. This work enhances their understanding of place value and can be applied to their growing understanding of fractions as pieces of totals or parts of groups. Further, students expand and deepen their understanding of measurement with regard to time, volume, and mass, and they gain experience in representing measurement data. Finally, students begin to connect properties of geometric objects, like area and perimeter, with their understanding of numeracy; they continue to classify, analyze, and compose geometric objects.

Junior Unit

With strong foundational mathematics skills, fourth and fifth graders are ready for the challenges of multiplicative reasoning, division, fractions, and decimals. Through number talks and mathematical investigations, students practice mental calculations, write equations, solve story problems, play math games, and use a variety of math tools and manipulatives. Junior Unit students continue to practice persevering through challenges, making sense of multi-step problems, and using prior knowledge to interpret new kinds of problems.



Fourth graders focus on developing fluency with multi-digit multiplication and they develop, discuss, and use efficient, accurate, and generalizable procedures to find quotients involving multi-digit dividends. They might show their learning by asking a question that can be solved using multi-digit multiplication and then make a book page that explains how to solve it using the standard algorithm and at least one other strategy. Fifth graders expand their understanding of place value and begin solidifying notions of fraction equivalence and comparison, as they practice fundamentals of adding and subtracting fractions, extending these ideas to include multiplication of fractions by whole numbers. Students also develop an understanding of decimal notation, representing simple fractions as decimals and vice versa. They practice converting measurements, develop additional representations of data, and develop more sophisticated understandings of geometric properties like angle measure and symmetry.

Fifth grade students continue to develop fluency in adding and subtracting fractions and develop a basic understanding of multiplying and dividing fractions. Confident in most other whole-number operations and place value, students can explain cogently not just how various arithmetic procedures work, but also why they work. Fifth graders continue to develop fluency in working with decimals using a variety of models and strategies and they become more sophisticated with interpretation and representation of data. They are developing precision in their communication, calculations, and measurements. Fifth graders use estimation to determine whether an answer is reasonable and check their work for accuracy.

Middle School

Middle school classrooms are buzzing with increasingly complex mathematical problem solving. Throughout the three years, students explore ratios and proportional relationships, rational numbers, linear algebra, and linear functions. Sixth graders apply their foundational understanding of fractions to ratios and proportional thinking. They develop efficient algorithms for performing adding, subtracting, multiplying, and dividing decimals. Students begin to represent unknown quantities with variables, and they reinforce their understanding of numbers by thinking statistically, in terms of variability and comparing distributions. Sixth graders also apply their understanding of geometric properties of two- and three-dimensional objects to solving more complex, applied problems. Each instructional unit focuses on understanding the power of making comparisons in mathematics with an aim toward strengthening proportional reasoning in later grades. During a cross-curricular project that integrates studies of human use of plants along with the production and economic distribution of free vs fair trade chocolate, students explore manipulating ratios in recipes and the percentage of cacao used to produce milk to dark chocolate.

Seventh graders concentrate on understanding proportional relationships and applying proportional reasoning. Students extend their understanding of number and operations to positive and negative fractions, and they become more fluent in representing unknown quantities with variables, simplifying basic variable expressions, and solving basic variable equations and inequalities. Seventh graders also apply their understanding of numbers to statistics, developing an understanding of sampling and comparing distributions. Students showcase their knowledge of probability through collaborating with peers to create and build an original carnival game. They provide all of the statistical data to show the likelihood of winning and losing their game and then present their creation and their calculations to the wider TPS community with a carnival, including a prize stand!

Eighth graders spend their year solidifying their understanding of the number system and operations, which now includes irrational numbers and negative exponents. Binomials, Polynomials, exponential functions, and the Pythagorean Theorem are all areas of focus. Our eight graders analyze and solve linear equations and inequalities and connect the idea of linearity to their sophisticated understanding of proportionality. They also begin to use



function notation and to look at geometric transformations, similarity, and congruence in terms of functional relationships. They solve more applied problems in geometry with more complex two- and three-dimensional objects. As part of an herbarium project that takes place during outdoor education and science classes back at school, students determine the diameter of a tree after measuring its circumference and identify trees that branch out in a pattern that follows the Fibonacci Sequence. Our 8th grade math experience culminates with our study of quadratic relationships, where students create projects depicting real-world applications of quadratics.