K-12 Mathematics Vision

In Dublin City Schools, we believe that *all students* deserve a mathematical learning experience centered around communication, collaboration, thinking and problem solving.

We believe that our students will become mathematicians through opportunities to:

- approach mathematics with curiosity, courage, confidence & intuition.
- think flexibly, critically and creatively with numbers and problems.
- take risks and persevere through robust problem solving.
- use math as a means to show the interconnectedness of our world.
- develop a mathematical mindset that emphasizes the importance of understanding and communicating process and not only providing precise answers.
- engage in mathematical discourse as the language of problem solving and innovative thinking.

This experience will prepare our students for college, career, and life as innovative thinkers and problem solvers of the future.

Advanced Integrated Mathematics Course Goals:

This course provides students with the opportunity to extend their knowledge from previous coursework in Algebra and Geometry, to deepen their thinking about mathematical concepts, and to apply skills in real life contexts using multiple approaches and technology. Students will also further develop their problem-solving skills to be successful in college math courses. Some advanced math topics will be introduced including, but not limited to matrix algebra, statistics & probability, trigonometry and other mathematical applications.

K-12 Course Mathematical Practices:

1. Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. Reason abstractly and quantitatively.
Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. Construct viable arguments and critique the reasoning of others.
Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also

able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. Look for and make use of structure.
Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

8. Look for and express regularity in repeated reasoning.
Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Course Content Standards:

Domain	Cluster	Standard
Trigonometry	Define trigonometric ratios, and solve problems involving right triangles.	G.SRT.8 Solve problems involving right triangles. (+) b. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
	Apply trigonometry to general triangles in problem situations.	(+) G.SRT.9 Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
		(+) G.SRT.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles, e.g., surveying problems.
Probability and Statistics	Statistics and Probability	DUB.AIM.1 Understand how data is produced, organized, summarized, and how to draw conclusions from data. (Displaying distributions with graphs, use and misuse of statistics, etc.)
		DUB.AIM.2 Introduce inferences. (i.e. confidence intervals, significance tests, use and abuse of statistical inference, Chi-Square Test, and inferences about a population mean, etc.)
		DUB.AIM.3 Develop an understanding of the basic ideas of statistical reasoning, comprehend methods needed to analyze and critically evaluate statistical arguments, and recognize the importance of statistical ideas.
		DUB.AIM.4 Encourage students to actively think about statistical issues arising in real-world problems and to understand the basic statistical techniques used to generate, summarize, and draw conclusions from data.
		DUB.AIM.5 Understand what big data is and how it is used in statistical analysis.
		DUB.AIM.6 Understand randomness, probability, and simulations. (Probability rules, conditional probability, probability distributions, and binomial distributions)
		DUB.AIM.7 Design experiments and explore ethical considerations.

		DUB.AIM.8 Describe relationships and display data. (i.e.Scatterplots and correlation, regression and prediction.)
		DUB.AIM.9 Interpret and apply Normal distribution to relevant data, including using the Central Limit Theorem when appropriate.
Algebraic Modeling & Applications	Analyze families of functions through applications. (linear, quadratic, polynomial, absolute value, exponential, logarithmic, trigonometric, rational, radical)	F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Include applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate. (i.e. Graph functions, indicating intercepts, end behavior, identifying zeros and asymptotes and factoring when reasonable.)
		DUB.AIM.10 Apply and solve equations and systems of equations in contextual scenarios through an integrating a variety of methods such as algebraic or geometric techniques, technology, graphing, matrices, etc.
		N.VM.6 (+) Use matrices to represent and manipulate data. (e.g., to represent payoffs or incidence relationships in a network)
		DUB.AIM.11 Combine functions using addition, subtraction, multiplication, and division analytically (include emphasis on rational functions).
		DUB.AIM.12 Determining an appropriate mathematical model to represent various real-world scenarios and data.
Financial Algebra	Apply a variety of problem-solving skills and strategies in real-world contexts relating to interest, loans, credit and other financial models.	DUB.AIM.13 Use technology to determine monthly payments for loans, study interest rates (i.e. APR in various context, savings accounts).
		DUB.AIM.14 Connect amortized loans with credit cards, car loans, mortgages, school loans (subsidized and unsubsidized).
		DUB.AIM.15 Apply geometric series and exponential growth/decay concepts in financial real world applications.
		DUB.AIM.16 Understand the difference between compound interest and an amortized loan.
		DUB.AIM.17 Analyze outcomes using mathematical models and data to support financial decisions.

		DUB.AIM.18 Create and investigate essential questions in finance by exploring the mathematical context and meaning supporting the question.
		DUB.AIM.19 Examine real-world financial data and make conclusions. (i.e. college loans, bank accounts, car loans, etc.)