Technical Math for College and Career

Content Standards

2022

Course Title: Technical Math for College and Career
Course/Unit Credit: 1
Course Number: 439130
Teacher Licensure: Please refer to the Course Code Management System (https://adedata.arkansas.gov/ccms/) for the most current licensure codes.
Grades: 9-12
Prerequisites: Algebra I and Geometry

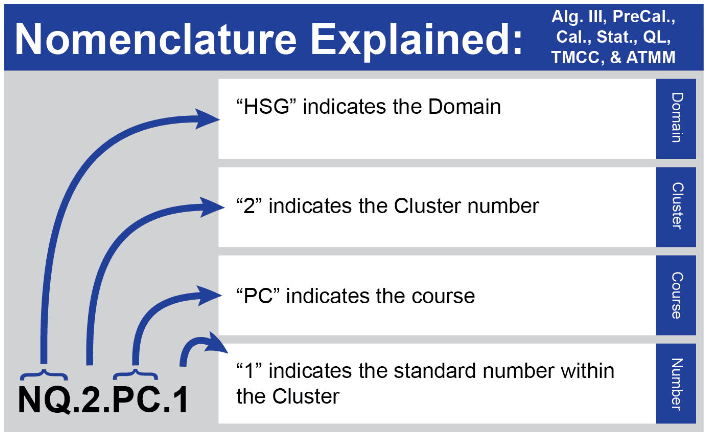
Course Description: Technical Math for College and Career builds on previous high school math courses to extend mathematical topics and relationships. Emphasis will be placed on the application of mathematics in context and on modeling – a process that uses mathematics to represent, analyze, make predictions, or otherwise provide insight into real-world situations. Students will collect, organize, describe, and use quantitative data and draw inferences from real-world data. Students will represent and process their reasoning and conclusions numerically, graphically, symbolically, and verbally. Technical Math for College and Career will help students develop mathematical proficiency needed for future course work and in careers including strategic competence (ability to formulate, represent, and solve mathematical problems) and adaptive reasoning (capacity for logical thought, reflection, explanation, and justification). Students will be expected to use technology, including graphing calculators, computers, or data-gathering tools, throughout the course. Technical Math for College and Career is a third or fourth year math course and does not require Arkansas Department of Education Division of Elementary and Secondary Education course approval.

Introduction to Secondary Arkansas Mathematics Standards

When the Division of Elementary and Secondary Education (DESE) began the process of revising math standards, a diverse group of qualified educators from across the state came together to craft Arkansas standards specific to the schools and students in the state. The result of this work, the Arkansas Mathematics Standards, is contained in this document. These standards reflect what educators across the state know to be best for Arkansas students.

Standards Organization: The revision committee maintained the organizational structure and nomenclature of the previous standards. Secondary Arkansas Mathematics Standards are categorized into domains, clusters, and standards.

- **Domains** represent the big ideas to be studied in each course and sometimes across grade bands. These big ideas support educators in determining the proper amount of focus and instructional time to be given to each of these topics.
- **Clusters** represent collections of standards grouped to help educators understand the building blocks of rich and meaningful instructional units. These units help students make connections within clusters and avoid seeing mathematics as a discrete list of skills they must master.
- **Standards** represent the foundational building blocks of math instruction. The standards outlined in this document work together to ensure that students are college and career ready and on track for success.



Standards Support: The revision of the Arkansas Mathematics Standards represent the work of the committee to provide greater clarity, strength, and support of the standards. Additionally, the revised mathematics standards are designed to help educators better understand the areas of emphasis and the focus within the standards. Educators should address the bulleted content as more than a checklist of items that they must teach individually. Content is bulleted to provide specificity of learning expectations included within some extensive standards. In some instances, the standard document includes Arkansas examples, teacher notes, specifications, and italicized words to assist educators with planning, teaching, and student learning.

- **Examples** included in the original standards were either changed for clarity or separated from the body of the actual standard. The examples included in the body of the standards document in no way reflect all of the possible examples. Likewise, these examples do not mandate curriculum or problem types. Local districts are free to select the high-quality curricula and instructional methods that best meet the needs of their students.
- **Teacher notes** offer clarification of the standards. These notes are intended to clarify, for teachers, what the expectations are for the learner. Likewise, these notes provide instructional guidance and limitations so that educators can better understand the scope of the standard. This will help with determining what is developmentally appropriate for students when working with specific standards.
- **Standard specifications** are to strengthen standards. The specifications are precise statements highlighting the need for mastery or function-type parameters for specific standards. This will assist educators in pinpointing the best opportunities for students to gain and master the knowledge and skills needed to succeed in a progression.
- **Asterisks (*)** are denoted to represent the modeling component of the standards. These standards should be presented in a modeling context which allows students to engage in the modeling process that is outlined in the Standards for Mathematical Process. (See Appendix A)
- **Italicized words** are defined in the glossary.

Finally, the Arkansas Mathematics Standards will be a living document. As these standards are implemented across schools in the state, DESE welcomes further suggestions related to notes of clarification, examples, professional development needs, and future revisions of the standards.

K - 12 Standards for Mathematical Practices	
1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics.	5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Technical Math for College and Career Standards: Overview	
Abbreviations: The following abbreviations are for the domains for the Arkansas Mathematics Standards.	
Numerical & Proportional Reasoning - NPR	
	1. Students will use number sense and proportional reasoning in real-world scenarios to make and communicate decisions in order to draw conclusions.
Mathematical Processes and Models- MPM	
	2. Students will use mathematical processes and models to acquire, demonstrate, and communicate mathematical understanding in real-world scenarios.
Algebraic Relationships - AR	
	3. Students will use mathematical concepts of algebra to explain linear and non-linear applications in real-world scenarios.
Measurement - M	
	4. Students will apply measurement and use measurement tools in real-world scenarios.
Geometry - G	
	5. Students will apply geometric concepts to real-world scenarios.

Numerical and Proportional Reasoning	
Cluster 1: Students will use number sense and proportional reasoning in real-world scenarios to make and communicate decisions in order to draw conclusions.	
NPR.1.TM.1*	Use estimation to identify the most reasonable mathematical solution.
NPR.1.TM.2*	Use estimation and precision in real-world scenarios. ● Know when ● Know how (e.g., use benchmarks for estimating) ● Know why
NPR.1.TM.3*	Solve real world-problems and interpret results involving calculations with percentages, decimals, and fractions. ● Conversions (e.g., percent to fraction or decimal, fraction to decimal or percent, decimal to fraction or percent) ● Percent change ● Percent of quantities
NPR.1.TM.4*	Recognize, set up, and solve proportions from real-world scenarios.
NPR.1.TM.5*	Utilize real-world scenarios requiring interpretation and comparison of various representations of rates, ratios, and proportions including scale drawings.
NPR.1.TM.6*	Compare magnitudes of numbers in context in different forms (e.g., place value, Richter scale, *scientific notation*, powers of 10).
NPR.1.TM.7*	Use dimensional analysis to solve problems involving multiple units of measurement (e.g., convert between and within the metric system and the U.S. customary system, determine miles per gallon, appropriate dosages of medicine).

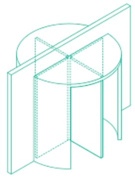
Mathematical Processes and Models	
Cluster 2: Students will use mathematical processes and models to acquire, demonstrate, and communicate mathematical understanding in real-world scenarios.	
MPM.2.TM.1*	Apply mathematics to problems arising in everyday life, workplace, and society.
MPM.2.TM.2*	Use mathematical processes with algebraic formulas (e.g., literal equations), numerical techniques, and graphs to solve real-world scenarios.

MPM.2.TM.3*	Create mathematical models and use problem-solving skills, independently and as a collaborative team, for real-world scenarios to: • Analyze given information or data • Identify patterns or relationships • Formulate a plan or strategy • Estimate solutions • Determine a solution • Justify a solution and its reasonableness • Describe limitations • Identify how results are affected by changing parameters (e.g., cost of materials, cost of labor, work time required to improve the overall cost of a project) • Suggest improvements
MPM.2.TM.4*	Select appropriate tools (e.g., real objects, manipulatives, paper and pencil, technology) and techniques (e.g., mental math, estimation, number sense) to solve problems.
MPM.2.TM.5*	Demonstrate effective use of resources (e.g., faculty, other students, reference materials, industry resources, Internet).
MPM.2.TM.6*	Use precise mathematical language and multiple representations (e.g., symbols, diagrams, graphs, written language) to communicate, independently and as a collaborative team, written or orally (e.g., reports, presentations, demonstrations), mathematical ideas or solutions to real-world scenarios.

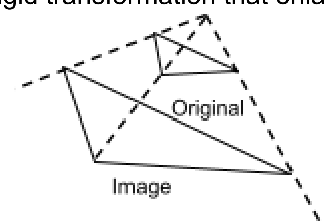
Algebraic Relationships	
Cluster 3:	**Students will use mathematical concepts of algebra to explain linear and non-linear applications in real-world scenarios.**
AR.3.TM.1*	Analyze and apply *rate of change* in terms of real-world scenarios (e.g., rise and run of stair stringers, roof pitch).
AR.3.TM.2*	Use concepts of *systems of equations* and *inequalities* (e.g., tables, graphs, pictorial representations, algebraic properties) to model and solve real-world scenarios (e.g., compare “best deal opportunities” with profit and expenses in businesses).
AR.3.TM.3	Use linear programming with or without the use of technology to. • Maximize or minimize (optimize) linear objective function in real-world scenarios. • Determine the reasonableness of solutions.
AR.3.TM.4*	Collect and organize data, independently and as a collaborative team, to create appropriate graphical representations (e.g., *scatter plots*, histograms, box plots, circle graphs) of real-world scenarios. • Interpret graphical representations. • Make predictions and decisions based on representations. • Analyze results based on representations.
AR.3.TM.5*	Create, interpret, and analyze best-fit models of *linear* and *exponential functions* to solve real-world scenarios. • Interpret the co*nstants*, *coefficients*, and bases in the context of the data. • Check the model for best fit and use the model, where appropriate, to draw conclusions or make predictions.

Measurement	
Cluster 4: Students will apply measurement and use measurement tools in real-world scenarios.	
M.4.TM.1*	Convert between and within the metric system and the U.S. customary system in real-world scenarios.
M.4.TM.2*	Demonstrate mastery of utilizing measuring devices: ● Apply accurate readings of both metric and the U.S. customary measuring devices (e.g., metric and standard ruler, tape measure, protractor, calipers, micrometer, thermometers, motion sensor, scales) to a problem situation. ● Select and use appropriate measuring devices and understand the limitations of such devices (e.g., flat surfaces, curved surfaces) for real-world scenarios.
M.4.TM.4*	Determine and use appropriate unit labels (e.g., length, distance, *area*, *surface area, volume*, weight, voltage, resistance, pressure, density) for real-world scenarios.

Geometry	
Cluster 5: Students will apply geometric concepts to real-world scenarios.	
G.5.TM.1*	Identify common geometric figures in order to identify what formulas are needed to solve situational problems (e.g., decompose and rearrange geometric figures).
G.5.TM.2*	Compute measurements of common geometric figures such as *area* (including *area* of sectors), *surface area, volume*, *perimeter,* and *circumference* (including *arc* length) for real-world scenarios.
G.5.TM.3*	Use trigonometric ratios (e.g., sine, cosine, tangent, angle of depression, angle of elevation) to calculate *angles* and lengths of sides in real-world scenarios.
G.5.TM.4*	Analyze how changing dimensions will affect the *perimeter*, *circumference*, *area, surface area*, or *volume* in real-world scenarios.
G.5.TM.5*	Determine the role *angles* play in a situational problem (e.g., structural strength and stability, angle straps for lifting, angles used to cut hair).
G.5.TM.6*	Apply right-triangle relationships using *Pythagorean Theorem*, *special right triangles,* and trigonometry in real-world scenarios (e.g., roof construction, building the frame of a car, calculating machined parts).
G.5.TM.7*	Draw and interpret with or without the use of technology: ● Auxiliary views ● Orthographic views ● Isometric views Teacher Note: Example: House plans, engineering drawings, fashion design

G.5.TM.8*	Demonstrate mastery of manipulating 2D and 3D figures. ● Use *cross-sections* of 3D shapes to relate to 2D figures. ● Use revolutions of 2D shapes to create a 3D object or space (e.g., revolving doors, honeycomb decorations). Example: 
G.5.TM.9*	Describe the *transformation* of *polygons* in the *coordinate plane* as they relate to real-world scenarios (e.g., cookie cutting, fabric cutting, machine dies): ● *Translation* ● *Reflection* ● *Rotation* ● *Dilation*

Glossary

Angle	Two rays that share a common endpoint. The rays are called the sides of the angle and the common endpoint is the vertex of the angle.
Arc of a circle	Any continuous (unbroken) part of the circumference of a circle.
Area	The measure of the size of the interior of a figure, expressed in square units.
Circumference	The perimeter of a circle, which is the distance around a circle.
Coefficient	A constant number or variable by which a variable is multiplied. Examples: $3x + 7$, 3 is the coefficient; $y = mx + b$, m is the coefficient
Constant	A fixed value; in $7x + 2 = 4$, 2 and 4 are constants.
Coordinate plane	A plane divided by perpendicular number lines creating four quadrants. The perpendicular number lines represent the axes and where they intersect represents the origin (0,0). Points can be identified using coordinates (x,y) found within the quadrants.
Cross-section	A plane figure obtained by the intersection of a solid with a plane.
Dilation	A nonrigid transformation that enlarges or reduces a geometric figure by a scale factor relative to a point. 
Equation	A statement that has one value or algebraic expression equal to another value or algebraic expression.
Exponential function	A function in which a variable appears in the exponent; $f(x) = 2^x$.
Inequality	A numerical sentence containing one of the symbols: >,<,≥,≤ or ≠ indicates the relationship between two quantities.
Linear function	A function characterized by a constant rate of change (slope).
Perimeter	The sum of the lengths of the sides of a polygon; the distance around a geometric figure.
Polygon	A closed plane figure whose sides are segments that intersect only at their endpoints, with each segment intersecting exactly two other segments.
Pythagorean Theorem	The mathematical relationship stating that in any right triangle the square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the two legs. ($a^2+b^2=c^2$)
Rate of change/Slope	The ratio of the vertical change compared to the horizontal change between two points on a coordinate plane. Slope is often expressed as $\frac{rise}{run}$ or $\frac{change\ in\ y}{change\ in\ x}$.
Reflection	A transformation in which every point and its image are on opposite sides and the same distance from a fixed line.
Rotation	A transformation in which each point is moved by the same angle measure in the same direction along a circular path about a fixed point

Scatter plot	A two-variable data display where points are plotted to show the relationship (correlation) between two variables.
Scientific Notation	A form of writing a number as the product of a power of 10 and a decimal number such that the absolute value of the decimal number is greater than or equal to one and less than ten.
Special right triangles	A triangle whose angles are either 30-60-90 degrees or 45-45-90 degrees.
Surface area	The sum of the areas of all of the surfaces of a solid.
Systems of equations	A set of two or more equations with the same variables. To solve a system is to find all common solutions or points that satisfy all equations.
Transformation	A rule that assigns to each point of a figure another point in the plane, called its image.
Translation	A transformation where each point is moved in the same direction and the same distance.
Volume	A measure of the amount of space contained in a solid expressed in cubic units.

Appendix A.

Mathematical Modeling Cycle

The basic modeling cycle is summarized in this diagram. It involves: (1) identifying variables in the situation and selecting those that represent essential features; (2) formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables; (3) analyzing and performing operations on these relationships to draw conclusions; (4) interpreting the results of the mathematics in terms of the original situation; (5) validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable; (6) reporting on the conclusions and the reasoning behind them. Choices, assumptions, and approximations are present throughout this cycle.