



**VIRGINIA BEACH CITY PUBLIC SCHOOLS**  
CHARTING THE COURSE

***Department of Teaching & Learning***  
***Parent/Student Course Information***

***GRADE 12 MATHEMATICS CAPSTONE***  
***(MA 3229)***  
***One credit, One year***

*Counselors are available to assist parents and students with course selections and career planning. Parents may arrange to meet with the counselor by calling the school's guidance department.*

**COURSE DESCRIPTION**

The course will augment skills in applied mathematical concepts through mathematical investigations targeting outcomes defined in *Virginia's College and Career Ready Mathematics Performance Expectations* (MPE). Students will research, collect and analyze data; develop and support ideas and conjectures; investigate, evaluate and incorporate appropriate resources; and determine appropriate problem-solving approaches and decision-making algorithms in a variety of real world contexts and applied settings. This is a year-long course that will count as one elective mathematics credit for graduation.

The mathematics capstone is designed for high school seniors who:

- have satisfactorily completed the required mathematics courses based on the Standards of Learning including Algebra, Functions and Data Analysis (AFDA) or Algebra II;
- have earned at least two verified credits in mathematics; and
- have plans to go to college but may not be fully college ready. The course may also support students who meet the same academic requirements but plan to enter the work force directly after graduating from high school.

**PREREQUISITE**

Algebra, Functions and Data Analysis or Algebra II

**OPTIONS FOR NEXT COURSE**

None

**REQUIRED TEXTBOOK**

None

**RECOMMENDED CALCULATOR**

TI-83 Plus, TI-84 Plus, TI-84 Plus C or TI-84 Plus CE or use Desmos online calculator

## Virginia Beach Instructional Objectives

### Grade 12 Mathematics Capstone – MA 3229

VBO#	Objective
	<b>Problem Solving, Decision Making and Integration</b>
<b>MA.CP.PS.1.1</b>	The student will solve practical problems involving rational numbers (including numbers in scientific notation), percents, ratios and proportions. <b>(MPE.1)</b>
<b>MA.CP.PS.1.2</b>	The student will collect and analyze data, determine the equation of the curve of best fit, make predictions and solve real world problems using mathematical models. Mathematical models will include polynomial, exponential and logarithmic functions. <b>(MPE.2)</b>
<b>MA.CP.PS.1.3</b>	The student will use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include: <ol style="list-style-type: none"> <li>a) investigating and using formulas for finding distance, midpoint and slope;</li> <li>b) applying slope to verify and determine whether lines are parallel or perpendicular;</li> <li>c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and</li> <li>d) determining whether a figure has been translated, reflected, rotated or dilated using coordinate methods. <b>(MPE.3)</b></li> </ol>
<b>MA.CP.PS.1.4</b>	The student will verify characteristics of quadrilaterals and use properties of quadrilaterals to solve real world problems. <b>(MPE.4)</b>
<b>MA.CP.PS.1.5</b>	The student will solve real world problems involving right triangles by using the Pythagorean Theorem and its converse, properties of special right triangles and right triangle trigonometry. <b>(MPE.5)</b>
<b>MA.CP.PS.1.6</b>	The student will use formulas for surface area and volume of three-dimensional objects to solve real world problems. <b>(MPE.6)</b>
<b>MA.CP.PS.1.7</b>	The student will use similar geometric objects in two- or three-dimensions to: <ol style="list-style-type: none"> <li>a) compare ratios between side lengths, perimeters, areas and volumes;</li> <li>b) determine how changes in one or more dimensions of an object affect area and/or volume of the object;</li> <li>c) determine how changes in area and/or volume of an object affect one or more dimensions of the object; and</li> <li>d) solve real world problems about similar geometric objects. <b>(MPE.7)</b></li> </ol>
<b>MA.CP.PS.1.8</b>	The student will compare distributions of two or more univariate data sets, analyzing center and spread (within group and between group variations), clusters and gaps, shapes, outliers or other unusual features. <b>(MPE.8)</b>
<b>MA.CP.PS.1.9</b>	The student will design and conduct an experiment/survey. Key concepts include: <ol style="list-style-type: none"> <li>a) sample size;</li> <li>b) sampling technique;</li> <li>c) controlling sources of bias and experimental error;</li> <li>d) data collection; and</li> <li>e) data analysis and reporting. <b>(MPE.9)</b></li> </ol>
<b>MA.CP.PS.1.10</b>	The student will investigate and apply the properties of arithmetic and geometric sequences and series to solve real world problems, including writing the first $n$ terms, finding the $n$ th term and evaluating summation formulas. Notation will include $\Sigma$ and $a_n$ .
<b>MA.CP.PS.1.11</b>	The student will use angles, arcs, chords, tangents and secants to: <ol style="list-style-type: none"> <li>a) investigate, verify and apply properties of circles;</li> </ol>

VBO#	Objective
	b) solve real world problems involving properties of circles; and c) find arc lengths and areas of sectors in circles.
<b>Understanding and Applying Functions</b>	
<b>MA.CP.FN.1.12</b>	The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables and words. Select and use appropriate representations for analysis, interpretation and prediction. <b>(MPE.12)</b>
<b>MA.CP.FN.1.13</b>	The student will investigate and describe the relationships among solutions of an equation, zeros of a function, x-intercepts of a graph and factors of a polynomial expression. <b>(MPE.13)</b>
<b>MA.CP.FN.1.14</b>	The student will recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. <b>(MPE.14)</b>
<b>MA.CP.FN.1.15</b>	The student will use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential and logarithmic). <b>(MPE.15)</b>
<b>MA.CP.FN.1.16</b>	The student will investigate and analyze functions (linear, quadratic, exponential and logarithmic families) algebraically and graphically. Key concepts include: <ul style="list-style-type: none"> <li>a) continuity;</li> <li>b) local and absolute maxima and minima;</li> <li>c) domain and range, including limited and discontinuous domains and ranges;</li> <li>d) zeros;</li> <li>e) x- and y-intercepts;</li> <li>f) intervals in which a function is increasing or decreasing;</li> <li>g) asymptotes;</li> <li>h) end behavior;</li> <li>i) inverse of a function;</li> <li>j) composition of multiple functions;</li> <li>k) finding the values of a function for elements in its domain; and</li> <li>l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic and algebraic. <b>(MPE.16)</b></li> </ul>
<b>MA.CP.FN.1.17</b>	The student will determine optimal values in problem situations by identifying constraints and using linear programming techniques. <b>(MPE.17)</b>
<b>Procedure and Calculation</b>	
<b>MA.CP.PC.1.18</b>	Given rational, radical or polynomial expressions, the student will: <ul style="list-style-type: none"> <li>a) add, subtract, multiply, divide and simplify rational algebraic expressions;</li> <li>b) add, subtract, multiply, divide and simplify radical expressions containing rational numbers and variables and expressions containing rational exponents;</li> <li>c) write radical expressions as expressions containing rational exponents and vice versa; and</li> <li>d) factor polynomials completely. <b>(MPE.18)</b></li> </ul>
<b>MA.CP.PC.1.19</b>	The student will graph linear equations and linear inequalities in two variables including: <ul style="list-style-type: none"> <li>a) determining the slope of a line when given an equation of the line, the graph of the line or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero or undefined; and</li> <li>b) writing the equation of a line when given the graph of the line, two points on the line or the slope and a point on the line. <b>(MPE.19)</b></li> </ul>

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<b>MA.CP.PC.1.20</b>	Given a point other than the origin on the terminal side of an angle, the student will use the definitions of the six trigonometric functions to find the sine, cosine, tangent, cotangent, secant and cosecant of the angle in standard position. Relate trigonometric functions defined on the unit circle to trigonometric functions defined in right triangles. <b>(MPE.20)</b>
<b>MA.CP.PC.1.21</b>	Given the coordinates of the center of a circle and a point on the circle, the student will write the equation of the circle. <b>(MPE.21)</b>
<b>MA.CP.PC.1.22</b>	The student will analyze graphical displays of univariate data, including dotplots, stemplots and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps and outliers. The student will use appropriate technology to create graphical displays. <b>(MPE.22)</b>
<b>MA.CP.PC.1.23</b>	The student will analyze the normal distribution. Key concepts include: a) characteristics of normally distributed data; b) percentiles; c) normalizing data using z-scores; and d) area under the standard normal curve and probability. <b>(MPE.23)</b>
<b>MA.CP.PC.1.24</b>	The student will describe orally and in writing the relationships between the subsets of the real number system. <b>(MPE.24)</b>
<b>MA.CP.PC.1.25</b>	The student will perform operations on complex numbers, express the results in simplest form using patterns of the powers of $i$ and identify field properties that are valid for the complex numbers. <b>(MPE.25)</b>
<b>MA.CP.PC.1.26</b>	The student will solve algebraically and graphically: a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. The student will use graphing calculators for solving and for confirming the algebraic solutions. <b>(MPE.26)</b>
<b>MA.CP.PC.1.27</b>	Given one of the six trigonometric functions in standard form, the student will: a) state the domain and the range of the function; b) determine the amplitude, period, phase shift, vertical shift and asymptotes; c) sketch the graph of the function by using transformations for at least a two-period interval; and d) investigate the effect of changing the parameters in a trigonometric function on the graph of the function. <b>(MPE.27)</b>
<b>MA.CP.PC.1.28</b>	The student will find, without the aid of a calculator, the values of the trigonometric functions of the special angles and their related angles as found in the unit circle. This includes converting angle measures from radians to degrees and vice versa. <b>(MPE.28)</b>
<b>MA.CP.PC.1.29</b>	The student will investigate and identify the characteristics of conic section equations in $(h, k)$ and standard forms. The student will use transformations in the coordinate plane to graph conic sections. <b>(MPE.29)</b>
<b>MA.CP.PC.1.30</b>	The student will, using two-way tables, analyze categorical data to describe patterns and departure from patterns and to find marginal frequency and relative frequencies, including conditional frequencies. <b>(MPE.30)</b>
<b>MA.CP.PC.1.31</b>	The student will calculate probabilities. Key concepts include: a) conditional probability; b) dependent and independent events;

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	c) addition and multiplication rules; d) counting techniques (permutations and combinations); and e) Law of Large Numbers. <b>(MPE.31)</b>
<b>Verification and Proof</b>	
<b>MA.CP.VP.1.32</b>	The student will use the relationships between angles formed by two lines cut by a transversal to: a) determine whether two lines are parallel; b) verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and c) solve real world problems involving angles formed when parallel lines are cut by a transversal. <b>(MPE.32)</b>
<b>MA.CP.VP.1.33</b>	Given information in the form of a figure or statement, the student will prove two triangles are congruent, using algebraic and coordinate methods as well as deductive proofs. <b>(MPE.33)</b>
<b>MA.CP.VP.1.34</b>	Given information in the form of a figure or statement, the student will prove two triangles are similar, using algebraic and coordinate methods as well as deductive proofs. <b>(MPE.34)</b>
<b>MA.CP.VP.1.35</b>	The student will construct and justify the constructions of: a) a line segment congruent to a given line segment; b) the perpendicular bisector of a line segment; c) a perpendicular to a given line from a point not on the line; d) a perpendicular to a given line at a given point on the line; e) the bisector of a given angle; f) an angle congruent to a given angle; and g) a line parallel to a given line through a point not on the given line. <b>(MPE.35)</b>
<b>MA.CP.VP.1.36</b>	The student will verify basic trigonometric identities and make substitutions, using the basic identities. <b>(MPE.36)</b>

### STRANDS OF MATHEMATICAL CONTENT

PS = Problem Solving, Decision Making, and Integration  
 PC = Procedure and Calculation

FN = Understanding and Applying Functions  
 VP = Verification and Proof

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Produced by the Department of Teaching and Learning.  
For further information, please call (757) 263-1070.

#### Notice of Non-Discrimination Policy

Virginia Beach City Public Schools does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation/gender identity, pregnancy, childbirth or related medical condition, disability, marital status, age, genetic information or veteran status in its programs, activities, employment, or enrollment, and provides equal access to the Boy Scouts and other designated youth groups. School Board policies and regulations (including, but not limited to, Policies 2-33, 4-4, 5-7, 5-19, 5-20, 5-44, 6-33, 6-7, 7-48, 7-49, 7-57 and Regulations 4-4.1, 4-4.2, 5-44.1, 7-11.1, 7-17.1 and 7-57.1) provide equal access to courses, programs, enrollment, counseling services, physical education and athletic, vocational education, instructional materials, extracurricular activities and employment.

Title IX Notice: Complaints or concerns regarding discrimination on the basis of sex or sexual harassment should be addressed to the Title IX Coordinator, at the VBCPS Office of Student Leadership, 641 Carriage Hill Road, Suite 200, Virginia Beach, 23452, (757) 263-2020, [Mary.Dees@vbschools.com](mailto:Mary.Dees@vbschools.com) (student complaints) or the VBCPS Department of School Leadership, 2512 George Mason Drive, Municipal Center, Building 6, Virginia Beach, Virginia, 23456 (757) 263-1088, [Elizabeth.Bryant@vbschools.com](mailto:Elizabeth.Bryant@vbschools.com) (employee complaints). Additional information regarding Virginia Beach City Public Schools' policies regarding discrimination on the basis of sex and sexual harassment, as well as the procedures for filing a formal complaint and related grievance processes, can be found in School Board Policy 5-44 and School Board Regulations 5-44.1 (students), School Board Policy 4-4 and School Board Regulation 4-4.3 (employees), and on the School Division's website at [Diversity, Equity and Inclusion/Title IX](#). Concerns about the application of Section 504 of the Rehabilitation Act should be addressed to the Section 504 Coordinator/Executive Director of Student Support Services at (757) 263-1980, 2512 George Mason Drive, Virginia Beach, Virginia, 23456 or the Section 504 Coordinator at the student's school. For students who are eligible or suspected of being eligible for special education or related services under IDEA, please contact the Office of Programs for Exceptional Children at (757) 263-2400, Plaza Annex/Family and Community Engagement Center, 641 Carriage Hill Road, Suite 200, Virginia Beach, VA 23452.

The School Division is committed to providing educational environments that are free of discrimination, harassment, and bullying. Students, staff, parents/guardians who have concerns about discrimination, harassment, or bullying should contact the school administration at their school. Promptly reporting concerns will allow the school to take appropriate actions to investigate and resolve issues. School Board Policy 5-7 addresses non-discrimination and anti-harassment, Policy 5-44 addresses sexual harassment and discrimination based on sex or gender. Policy 5-36 and its supporting regulations address other forms of harassment.

Alternative formats of this publication which may include taped, Braille, or large print materials are available upon request for individuals with disabilities. Call or write the Department of Teaching and Learning, Virginia Beach City Public Schools, 2512 George Mason Drive, P.O. Box 6038, Virginia Beach, VA 23456-0038. Telephone 263-1070 (voice); fax 263-1424; 263-1240 (TDD) or email him at [George.Coker@vbschools.com](mailto:George.Coker@vbschools.com).

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