



MATHEMATICS

Graduation Requirement Guidance 2016 – 2017

Mathematics Graduation Requirement Guidance

2016 - 2017

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Executive Summary

Successful preparation for both postsecondary education and employment requires learning the same rigorous mathematics content and skills. No longer do students planning to enter the workplace after high school need a different and less rigorous mathematics curriculum than those planning to go to college. (Achieve, Inc., 2004)

In 2007, Georgia's State Board of Education adopted rigorous new graduation requirements effective with the ninth grade class of 2008. A hallmark of the rule was the elimination of tiered-diploma options where students followed either College Preparatory or Technology/Career coursework. All students are expected to complete a common set of mathematics requirements to earn a regular diploma. The rule specifies certain mathematics courses that all students must take – making rigorous content an expectation for all and not just for some of Georgia's students and ensuring that all students are given the opportunity to choose mathematics courses that could include Advanced Placement, International Baccalaureate, and dual enrollment courses. Additionally, the rule encourages active student involvement in selecting mathematics courses based on the students' areas of interest.

The Georgia State Board of Education's 2015 adoption of the Georgia Standards of Excellence (GSE) in mathematics was a significant step toward ensuring that Georgia's K-12 students are prepared to enter the 21st century global workplace. **The Standards are intended to be a living work; so as new and better evidence emerges, the Standards will be revised accordingly.** As a natural outgrowth of meeting the charge to define college and career readiness, the Standards define what students should understand and be able to do in their study of mathematics. Georgia's mathematics standards are called Georgia Standards of Excellence for Mathematics (MGSE) and were fully implemented in Kindergarten – High School classrooms in school year 2015-2016.

MATHEMATICS

The Standards for *Mathematical Practice* represent the habits and attitudes of mathematical thinkers and are integral to the superstructure of GSE mathematics. The practice standards define the way knowledge comes together and is used by students. The Standards for *Mathematical Practice* describe the expertise that mathematics educators at all levels should seek to develop in their students. The practices are as follows:

- Make sense of problems and persevere in solving them;
- Reason abstractly and quantitatively;
- Construct viable arguments and critique the reasoning of others;
- Model with mathematics;
- Use appropriate tools strategically;
- Attend to precision;
- Look for and make use of structure;
- Look for and express regularity in repeated reasoning.

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The Standards *for Mathematical Content* offer a balanced combination of procedure and understanding.

A lack of understanding effectively prevents a student from engaging in the mathematical practices. Designers of curriculum, assessment, and professional development should all attend to the need to connect mathematical practice to mathematical content in mathematics instruction.

Mathematics requirements associated with the graduation rule are currently aligned with the Georgia Standards of Excellence (GSE) for mathematics. A wide range of mathematics courses provide opportunities for students to continue advanced coursework, to take advantage of academic support classes, and to choose special interest courses, depending on individual needs and aspirations. An increased number of students with disabilities now have the opportunity to earn a regular education diploma, thus enabling them to become employed or to go on to postsecondary education. The mathematics graduation requirements associated with the graduation rule, along with state curriculum standards and assessments, will ensure that more students finish school ready to thrive in our knowledge-based, high-skills economy.

Key Feature of the State Board of Education Rule 160-4-2-.48 Requirements

Four units of core credit in mathematics, including Coordinate Algebra or Algebra I or the equivalent; Analytic Geometry or Geometry or the equivalent; and Advanced Algebra or Algebra II or the equivalent. Additional core courses needed to complete four credits in mathematics must be chosen from the list of GSE/AP/IB/dual enrollment designated courses.

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Section 1: Georgia HS Graduation Requirements

Four units of credit in mathematics shall be required of all students, to include:

- Coordinate Algebra or Algebra I or the equivalent,
- Analytic Geometry or Geometry or the equivalent,
- Advanced Algebra or Algebra II or the equivalent, and
- One Additional Unit to be selected from the list of GSE/AP/IB/dual enrollment designated courses.

NOTE: Accelerated Coordinate Algebra/Analytic Geometry A and Accelerated Analytic Geometry B/Advanced Algebra include the standards of Coordinate Algebra, Analytic Geometry, and Advanced Algebra. At the present time, these are the only equivalent courses for Coordinate Algebra, Analytic Geometry, and Advanced Algebra. Accelerated Algebra I/Geometry A and Accelerated Geometry B/Algebra II include the standards of Algebra I, Geometry, and Algebra II. At the present time, these are the only equivalent courses for Algebra I, Geometry, and Algebra II.

NOTE: Students who complete the alternative sequence Coordinate Algebra + Analytic Geometry + Pre-Calculus + a fourth mathematics course beyond Pre-Calculus have met the mathematics graduation requirement.

Students with disabilities who earn credit in Coordinate Algebra or Algebra I or the equivalent, along with the associated support course, *and* Analytic Geometry or Geometry or the equivalent, along with the associated support course, may upon the determination through the Individualized Education Program Team meet the mathematics diploma requirements by completing Advanced Algebra or Algebra II or the equivalent, for a total of 3 mathematics core credits. Successful completion of 3 core units of mathematics may not meet the mathematics admission requirements for entrance into a University System of Georgia institution or other post-secondary institution without additional course work.

Students with disabilities who were identified prior to enrollment in high school and have a disability affecting mathematics achievement may follow an alternative course sequence to meet the mathematics course requirements of the graduation rule 160-4-2-.48. The alternate course sequences include:

- 1) enrollment in a single advanced mathematics course and receiving instruction over two years or
- 2) dispensation from completing Advanced Algebra or Algebra II.

These alternative course sequences would allow a student with disabilities earning core credit in Coordinate Algebra or Algebra I and Analytic Geometry or Geometry, along with two other mathematics courses, to satisfy the minimum mathematics requirements for high school graduation. For further detail, please see Guidelines for Georgia State Board of Education Rule 160-5-1-.15 AWARDING UNITS OF CREDIT AND ACCEPTANCE OF TRANSFER CREDIT AND/OR GRADES section 2(e).

High school credit for mathematics courses taken in middle school should be awarded only for courses that include concepts and skills based on the GSE in Mathematics for grades 9-12 or those approved by the State Board of Education. All course requirements, including associated End of Course requirements, must be met prior to granting credit.

High School credit is **not** awarded for courses that address concepts and skills associated with grades K-8.

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| Entered Ninth Grade in 2011-2012 | Entered Ninth Grade in 2012-2013 and Subsequent Years |
|--|--|
| Graduation Rule 160-4-2-.48 | Awarding Units of Credit Rule 160-5-1-.15 |
| 4 units of core credit in mathematics | 4 units of core credit in mathematics |
| <ul style="list-style-type: none"> ○ 1 unit in Mathematics I or the equivalent | <ul style="list-style-type: none"> ○ 1 unit in Coordinate Algebra or Algebra I or the equivalent |
| <ul style="list-style-type: none"> ○ 1 unit in Mathematics II or the equivalent | <ul style="list-style-type: none"> ○ 1 unit in Analytic Geometry or Geometry or the equivalent |
| <ul style="list-style-type: none"> ○ 1 unit in Mathematics III or the equivalent | <ul style="list-style-type: none"> ○ 1 unit in Advanced Algebra or Algebra II or the equivalent |
| <ul style="list-style-type: none"> ○ Support courses are designated as elective courses | <ul style="list-style-type: none"> ○ Support courses are designated as elective courses |
| <ul style="list-style-type: none"> ○ Additional core mathematics credits must be chosen from the list of GPS/CCGPS/AP/IB/dual enrollment designated courses | <ul style="list-style-type: none"> ○ Additional core mathematics credits must be chosen from the list of GSE/AP/IB/dual enrollment designated courses |
| <p>Students with Disabilities who earn credit in GPS Mathematics I or the equivalent, along with the associated support course, <i>and</i> GPS Mathematics II or the equivalent, along with the associated support course, may upon determination of the Individualized Education Program Team meet the mathematics diploma requirements by completing GPS Mathematics III or the equivalent, for a total of 3 mathematics core credits.</p> | <p>Students with Disabilities who earn credit in Coordinate Algebra or Algebra I or the equivalent, along with the associated support course, <i>and</i> Analytic Geometry or Geometry or the equivalent, along with the associated support course, may upon determination of the Individualized Education Program Team meet the mathematics diploma requirements by completing Advanced Algebra or Algebra II or the equivalent, for a total of 3 mathematics core credits.</p> |
| <p>Students with Disabilities, who were identified prior to enrollment in high school and have a disability affecting mathematics achievement, may follow an alternative course sequence to meet the mathematics course requirements of the graduation rule 160-4-2-.48. The alternative course sequences include 1) students enrolling in a single advanced mathematics course and receiving instruction over two years or 2) receiving dispensation from completing Mathematics III. These alternative course sequences would allow a student with disabilities earning core credit in Mathematics I and II with two other mathematics courses to satisfy the minimum mathematics requirements for high school graduation.</p> | <p>Students with Disabilities, who were identified prior to enrollment in high school and have a disability affecting mathematics achievement, may follow an alternative course sequence to meet the mathematics course requirements of the graduation rule 160-4-2-.48. The alternative course sequences include 1) students enrolling in a single advanced mathematics course and receiving instruction over two years or 2) receiving dispensation from completing Advanced Algebra or Algebra II. These alternative course sequences would allow a student with disabilities earning core credit in Coordinate Algebra or Algebra I and Analytic Geometry or Geometry with two other mathematics courses to satisfy the minimum mathematics requirements for high school graduation.</p> |

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Section 2: Mathematics Course Sequence Information

| Mathematics Sequence Options for Grades 6 - 12 | | | | | | |
|--|---------------------------------------|---|--|--|---|--|
| GRADE | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 | Option 6 |
| | | | | Advanced | Accelerated | Accelerated |
| 6 | Grade 6 | Grade 6 | Grade 6 | Grade 6 Advanced | Grade 6-8 Advanced | Grade 6-8 Advanced |
| 7 | Grade 7 | Grade 7 | Grade 7 | Grade 7 Advanced | | |
| 8 | Grade 8 | Grade 8 | Grade 8 | Grade 8 Advanced | Coordinate Algebra OR Algebra I | Accelerated Coordinate Algebra/Analytic Geometry A OR Accelerated Algebra I/ Geometry A |
| 9 | Foundations of Algebra | Coordinate Algebra OR Algebra I | Accelerated Coordinate Algebra/Analytic Geometry A OR Accelerated Algebra I/ Geometry A | Accelerated Coordinate Algebra/Analytic Geometry A OR Accelerated Algebra I/ Geometry A | Analytic Geometry OR Geometry | Accelerated Analytic Geometry B/Advanced Algebra OR Accelerated Geometry B/ Algebra II |
| 10 | Coordinate Algebra OR Algebra I | Analytic Geometry OR Geometry | Accelerated Analytic Geometry B/Advanced Algebra OR Accelerated Geometry B/ Algebra II | Accelerated Analytic Geometry B/Advanced Algebra OR Accelerated Geometry B/ Algebra II | Advanced Algebra OR Algebra II | Accelerated Pre-Calculus |
| 11 | Analytic Geometry OR Geometry | Advanced Algebra OR Algebra II | Accelerated Pre-Calculus | Accelerated Pre-Calculus | Fourth Mathematics Course Options*; IB Courses**; Dual Enrollment Courses | Fourth Mathematics Course Options*; IB Courses**; Dual Enrollment Courses |
| 12 | Advanced Algebra OR Algebra II | Fourth Mathematics Course Options*; IB Courses**; Dual Enrollment Courses | Fourth Mathematics Course Options*; IB Courses**; Dual Enrollment Courses | Fourth Mathematics Course Options*; IB Courses**; Dual Enrollment Courses | Fourth Mathematics Course Options*; IB Courses**; Dual Enrollment Courses | Fourth Mathematics Course Options*; IB Courses**; Dual Enrollment Courses |

* Fourth Mathematics Course Options are listed in Chart A on page 8.

**International Baccalaureate Course Sequences are provided in Chart B on page 9.

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CHART A: Fourth Mathematics Course Options

| | Fourth Mathematics Course | Suggested Prerequisite Courses |
|----------|--|--|
| 27.04810 | Foundations of Algebra | Mathematics Grade 8 |
| 27.09740 | Pre- Calculus | Algebra I + Geometry + Algebra II OR Coordinate Algebra + Analytic Geometry + Advanced Algebra Accelerated Algebra I/Geometry A + Accelerated Geometry B/Algebra II OR Accelerated Coordinate Algebra/Analytic Geometry A + Accelerated Analytic Geometry B/ Advanced Algebra |
| 27.08500 | Advanced Mathematical Decision Making (AMDM) | Algebra I + Geometry + Algebra II OR Coordinate Algebra + Analytic Geometry + Advanced Algebra Accelerated Algebra I/Geometry A + Accelerated Geometry B/Algebra II OR Accelerated Coordinate Algebra/Analytic Geometry A + Accelerated Analytic Geometry B/ Advanced Algebra |
| 27.08800 | Statistical Reasoning | Algebra I + Geometry + Algebra II OR Coordinate Algebra + Analytic Geometry + Advanced Algebra Accelerated Algebra I/Geometry A + Accelerated Geometry B/Algebra II OR Accelerated Coordinate Algebra/Analytic Geometry A + Accelerated Analytic Geometry B/ Advanced Algebra |
| 27.08600 | Mathematics of Industry and Government (MIG) | Algebra I + Geometry + Algebra II OR Coordinate Algebra + Analytic Geometry + Advanced Algebra Accelerated Algebra I/Geometry A + Accelerated Geometry B/Algebra II OR Accelerated Coordinate Algebra/Analytic Geometry A + Accelerated Analytic Geometry B/ Advanced Algebra |
| 27.08900 | College Readiness Mathematics | Algebra I + Geometry + Algebra II OR Coordinate Algebra + Analytic Geometry + Advanced Algebra |
| 27.08700 | Mathematics of Finance (MOF) | LEA Flexibility |
| 27.07800 | Calculus | Algebra I + Geometry + Algebra II + Pre-Calculus OR Coordinate Algebra + Analytic Geometry + Advanced Algebra + Pre-Calculus Accelerated Algebra I/Geometry A + Accelerated Geometry B/Algebra II + Accelerated Pre-Calculus OR Accelerated Coordinate Algebra/Analytic Geometry A + Accelerated Analytic Geometry B/ Advanced Algebra + Accelerated Pre-Calculus |
| 27.07400 | AP Statistics | Algebra I + Geometry + Algebra II OR Coordinate Algebra + Analytic Geometry + Advanced Algebra Accelerated Algebra I/Geometry A + Accelerated Geometry B/Algebra II OR Accelerated Coordinate Algebra/Analytic Geometry A + Accelerated Analytic Geometry B/ Advanced Algebra |
| 27.07200 | AP Calculus AB | Algebra I + Geometry + Algebra II + Pre-Calculus OR Coordinate Algebra + Analytic Geometry + Advanced Algebra + Pre-Calculus Accelerated Algebra I/Geometry A + Accelerated Geometry B/Algebra II + Accelerated Pre-Calculus OR Accelerated Coordinate Algebra/Analytic Geometry A + Accelerated Analytic Geometry B/ Advanced Algebra + Accelerated Pre-Calculus |
| 27.07300 | AP Calculus BC | Accelerated Algebra I/Geometry A + Accelerated Geometry B/Algebra II + Accelerated Pre-Calculus OR Accelerated Coordinate Algebra/Analytic Geometry A + Accelerated Analytic Geometry B/ Advanced Algebra + Accelerated Pre-Calculus |
| 27.05200 | History of Mathematics | AP Calculus AB or BC (may be taken concurrently with AP Calculus); 0.5 elective credit only |
| 27.07700 | Multivariable Calculus | AP Calculus BC |
| 27.08000 | Engineering Calculus | AP Calculus BC |
| 27.07900 | Advanced Mathematical Topics | AP Calculus AB or BC |

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CHART B: International Baccalaureate Mathematics Course Sequences

| Grade | Option 1 | Option 2 | | Option 3 | Option 4 | Option 5 | Option 6 |
|-------|---------------------------------------|---|---|---|---|---|--|
| | | | | | | MS Acceleration | MS Acceleration |
| 6 | Grade 6 | Grade 6 | | Grade 6 | Grade 6 | Grades 6-8 | Grades 6-8 |
| 7 | Grade 7 | Grade 7 | | Grade 7 | Grade 7 | | |
| 8 | Grade 8 | Grade 8 | | Grade 8 | Grade 8 | Algebra I OR Coordinate Algebra | Accelerated Algebra I /Geometry A OR Coordinate Algebra/Analytic Geometry A |
| 9 | Algebra I OR Coordinate Algebra | Algebra I OR Coordinate Algebra | | Accelerated Algebra I /Geometry A OR Coordinate Algebra/Analytic Geometry A | Accelerated Algebra I /Geometry A OR Coordinate Algebra/Analytic Geometry A | Geometry OR Analytic Geometry | Accelerated Geometry B/ Algebra II OR Accelerated Analytic Geometry B/Advanced Algebra |
| 10 | Geometry OR Analytic Geometry | Geometry OR Analytic Geometry | | Accelerated Geometry B/ Algebra II OR Accelerated Analytic Geometry B/ Advanced Algebra | Accelerated Geometry B/ Algebra II OR Accelerated Analytic Geometry B/ Advanced Algebra | Algebra II OR Advanced Algebra | Accelerated Pre-Calculus OR IB Mathematical Studies – Year 1* |
| 11 | Algebra II OR Advanced Algebra | Algebra II OR Advanced Algebra Block | Pre-Calculus OR IB Mathematical Studies - Year 1* Block | Accelerated Pre-Calculus OR IB Mathematical Studies – Year 1* | Accelerated Pre-Calculus OR IB Mathematical Studies – Year 1* | IB Mathematical Studies – Year 1* | IB Mathematics – Year 1* OR AP Calculus AB |
| 12 | IB Mathematical Studies – Year 1 | IB Mathematics – Year 1 OR IB Mathematical Studies – Year 2 | | IB Mathematics – Year 1 OR IB Mathematical Studies – Year 2 | IB Mathematics – Year 2 OR AP Calculus AB/BC AP Statistics | IB Mathematics – Year 1 OR IB Mathematical Studies – Year 2 | IB Mathematics – Year 2 OR AP Calculus AB/BC AP Statistics |

**After students meet the diploma requirements for IB Standard Level, additional choices for the fourth year could include Advanced Mathematical Decision Making, Mathematics of Industry and Government, Mathematics of Finance, Statistical Reasoning, AP Statistics, and AP Calculus AB/BC.*

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Move On When Ready (MOWR) Mathematics Dual Enrollment Program

Effective 2016-2017, MOWR mathematics courses have been provided unique course codes and titles which demonstrate the college level course and the institution where the courses were completed. For additional clarification, a MOWR Mathematics Frequently Asked Questions document can be found at <https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Pages/Mathematics.aspx>.

High school students are prepared for college level degree courses after mastering the college readiness standards associated with Advanced Algebra or Algebra II. For that reason, all approved MOWR mathematics courses provide options for meeting the fourth course beyond Advanced Algebra/Algebra II graduation requirement. Very talented mathematics students who choose the alternative mathematics course sequence Coordinate Algebra + Analytic Geometry + Pre-Calculus or MOWR Pre-Calculus are prepared for college level courses beyond Pre-Calculus.

NOTES: Accelerated Coordinate Algebra/Analytic Geometry A and Accelerated Analytic Geometry B/Advanced Algebra include the standards of Coordinate Algebra, Analytic Geometry, and Advanced Algebra. At the present time, these are the only equivalent courses for Coordinate Algebra, Analytic Geometry, and Advanced Algebra.

Accelerated Algebra I/Geometry A and Accelerated Geometry B/Algebra II include the standards of Algebra I, Geometry, and Algebra II. At the present time, these are the only equivalent courses for Algebra I, Geometry, and Algebra II.

Neither the Georgia High School Graduation Rule, nor policy established by the Technical College System of Georgia or the University System of Georgia, endorses MOWR College Algebra as an equivalent of Advanced Algebra/Algebra II.

In rare instances, very talented mathematics students will choose the alternative mathematics course sequence Coordinate Algebra/Algebra I + Analytic Geometry/Geometry + Pre-Calculus or MOWR Pre-Calculus and will have mastered the GSE mathematics standards associated with Advanced Algebra/Algebra II within the Pre-Calculus course. In this case, while Pre-Calculus is not an equivalent course for Advanced Algebra/Algebra II, the Advanced Algebra/Algebra II graduation requirement has been met with an expectation of enrollment in higher-level courses beyond Pre-Calculus.

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Section 3: High School Mathematics Course Descriptions

Georgia Mathematics

Georgia Mathematics focuses on actively engaging the student in the development of mathematical understanding by working independently and cooperatively to solve problems, estimating and computing efficiently, using appropriate tools, concrete models, and a variety of representations, and conducting investigations and recording findings. There is a shift toward applying mathematical concepts and skills in the context of authentic problems and student understanding of concepts rather than merely following a sequence of procedures. In mathematics classrooms, students will learn to think critically in a mathematical way with an understanding that there are many different solution pathways and sometimes more than one right answer in applied mathematics. Mathematics is the economy of information. The central idea of all mathematics is to discover how knowing some things leads, via reasoning, to knowing more—without having to commit the information to memory as a separate fact. It is the reasoned, logical connections that make mathematics manageable. The implementation of the Georgia Standards of Excellence in Mathematics places the expected emphasis on sense-making, problem solving, reasoning, representation, modeling, representation, connections, and communication.

High School Mathematics

Foundations of Algebra is a first year high school mathematics course option for students who have completed mathematics in grades 6 – 8 yet will need substantial support to bolster success in high school mathematics. The course is aimed at students who have reported low standardized test performance in prior grades and/or have demonstrated significant difficulties in previous mathematics classes.

Algebra I is the first course in a sequence of three required high school courses designed to ensure career and college readiness. The course represents a discrete study of algebra with correlated statistics applications.

Coordinate Algebra is the first course in a sequence of three high school courses designed to ensure career and college readiness. The course represents a discrete study of algebra with correlated statistics applications and a bridge to the second course through coordinate geometric topics.

Geometry is the second course in a sequence of three required high school courses designed to ensure career and college readiness. The course represents a discrete study of geometry with correlated statistics applications.

Analytic Geometry is the second course in a sequence of three high school courses designed to ensure career and college readiness. The course embodies a discrete study of geometry analyzed by means of algebraic operations with correlated probability/statistics applications and a bridge to the third course through algebraic topics.

Algebra II/ Advanced Algebra is the third course in a sequence of three high school courses designed to ensure career and college readiness. It is designed to prepare students for fourth course options relevant to their career pursuits.

Accelerated Algebra I/ Geometry A is the first course in a sequence of mathematics courses designed to ensure that students are prepared to take higher-level mathematics courses during their high school tenure, including Advanced Placement Calculus AB, Advanced Placement Calculus BC, and Advanced Placement Statistics

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Accelerated Coordinate Algebra/Analytic Geometry A is the first course in a sequence of mathematics courses designed to ensure that students are prepared to take higher-level mathematics courses during their high school tenure, including Advanced Placement Calculus AB, Advanced Placement Calculus BC, and Advanced Placement Statistics.

Accelerated Geometry B/Algebra II is the second course in a sequence of mathematics courses designed to ensure that students are prepared to take higher-level mathematics courses during their high school tenure, including Advanced Placement Calculus AB, Advanced Placement Calculus BC, and Advanced Placement Statistics.

Accelerated Analytic Geometry B/Advanced Algebra is the second course in a sequence of mathematics courses designed to ensure that students are prepared to take higher-level mathematics courses during their high school tenure, including Advanced Placement Calculus AB, Advanced Placement Calculus BC, and Advanced Placement Statistics.

Accelerated Pre-Calculus is a the third course mathematics in a sequence of mathematics courses designed to ensure that students are prepared to take higher-level mathematics courses during their high school tenure, including Advanced Placement Calculus AB, Advanced Placement Calculus BC, and Advanced Placement Statistics.

Pre-Calculus is a fourth mathematics course option designed to follow the completion of Algebra II, Advanced Algebra, Accelerated Geometry B/Algebra II, or Accelerated Analytic Geometry B/Advanced Algebra, which prepares students for calculus and other higher-level mathematics courses.

Advanced Mathematical Decision Making is a fourth course option designed to follow the completion of Algebra II, Advanced Algebra, Accelerated Geometry B/Algebra II, or Accelerated Analytic Geometry B/Advanced Algebra, which offers further experiences with statistical information and summaries, methods of designing and conducting statistical studies, data modeling, basic financial decisions, and network models for making informed decisions.

Mathematics of Industry and Government is a fourth course option designed to follow the completion of Algebra II, Advanced Algebra, Accelerated Geometry B/Algebra II, or Accelerated Analytic Geometry B/Advanced Algebra, which focuses on the development of mathematical models that can be used to model, improve, predict, and optimize real-world systems. These mathematical models include both deterministic models such as mathematical programming, routing, or network flows, and probabilistic models such as queuing, and simulation.

Mathematics of Finance is a fourth course option which concentrates on the mathematics necessary to understand and make informed decisions related to personal finance. The mathematics in the course is based on many topics in prior courses; however, the specific applications will extend the student's understanding of when and how to use these topics.

Statistical Reasoning is a fourth mathematics course option for students who have completed Algebra II, Advanced Algebra, Accelerated Geometry B/Algebra II, or Accelerated Analytic Geometry B/Advanced Algebra, which offers opportunities to strengthen the understanding of the statistical method of inquiry and statistical simulations.

College Readiness Mathematics is a fourth mathematics course option for students who have completed Algebra II or Advanced Algebra, but are still struggling with high school mathematics standards essential for success in first year post-secondary mathematics courses required for non-STEM majors. The course is designed to serve as a bridge for high school students who will enroll in non-STEM post-secondary study.

Calculus is a fourth mathematics course option for students who have completed Pre-Calculus or Accelerated Pre-Calculus. The course includes problem solving, reasoning and estimation, functions, derivatives, application of the derivative, integrals, and application of the integral.

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Advanced Mathematical Topics is a mathematics option for students who have completed AP Calculus AB or AP Calculus BC. The course offers an introduction to advanced mathematical topics including logic and set theory, combinatorics, differential equations, and mathematical proofs, to be presented through an abstract approach which characterizes upper level mathematics courses.

Multivariable Calculus is a mathematics option for students who have completed AP Calculus BC. It includes three-dimensional coordinate geometry; matrices and determinants; eigenvalues and eigenvectors of matrices; limits and continuity of functions with two independent variables; partial differentiation; multiple integration; the gradient; the divergence; the curl; Theorems of Green, Stokes, and Gauss; line integrals; integrals independent of path; and linear first-order differential equations.

Engineering Calculus is a mathematics option for students who have completed AP Calculus BC. The course provides students with opportunities to develop an understanding of multivariable calculus as it applies to engineering systems, the history of engineering, and its contributions to society. The course includes three-dimensional coordinate geometry; matrices and determinants; limits and continuity of functions with two independent variables; partial differentiation; multiple integration; the gradient; the divergence; the curl; Theorems of Green, Stokes, and Gauss; line integrals; integrals independent of path; and linear first-order differential equations.

History of Mathematics is a one-semester **elective** course option for students who have completed AP Calculus or are taking AP Calculus concurrently. It traces the development of major branches of mathematics throughout history, specifically algebra, geometry, number theory, and methods of proofs, how the needs of various cultures influenced that development, and how the mathematics, in turn, influenced culture. The course extends the numbers and counting, algebra, geometry, and data analysis and probability strands from previous courses, and includes a new history strand.

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Section 4: Student Placement

Student Placement for Students Entering Ninth Grade from a Georgia School

Determination of course placement should depend on the student's interest in mathematics and/or related fields of study and on the student's achievement in mathematics.

Students who have successfully completed mathematics in grades 6 – 8 have mastered the content necessary to be successful in **Algebra I or Coordinate Algebra**.

The Georgia mathematics program of study provides the opportunity for students with an interest and desire to study mathematics to challenge themselves by taking the more rigorous courses **Accelerated Algebra I/Geometry A** or **Accelerated Coordinate Algebra/Analytic Geometry A**. Given the alignment of the standards, students who have difficulty in the accelerated mathematics sequence will be able to transition easily to the regular mathematics sequence. As the pace and rigor of accelerated mathematics courses is significantly more challenging than that of the regular mathematics sequence, students placed in an accelerated mathematics course should have strong mathematical skills and an interest in pursuing Advanced Placement or other higher-level mathematics courses while still in high school. Schools should consider equity and access for all when assigning students to the accelerated mathematics sequence of courses.

Students who will require **additional** support for success in Algebra I or Coordinate Algebra are best served through placement in **Algebra I or Coordinate Algebra Support** concurrent with enrollment in Algebra I or Coordinate Algebra. Students should be enrolled in mathematics support courses based on local system criteria for identifying students who are at risk for failing mathematics. Students who are *placed* in high school and have not passed the grade 8 math state assessment should certainly be afforded the benefit of a support course. Other criteria might include teacher recommendation based on student performance in the previous or current mathematics course, prior retention, a failing grade in a mathematics course, and/or low scores on the mathematics component of the state assessment or other instruments used by the system to predict success.

Students who have completed mathematics in grades 6 – 8 yet will need **substantial** support to bolster success in high school mathematics should be considered for enrollment in the **Foundations of Algebra** course prior to enrollment in Algebra I or Coordinate Algebra.

The local school or system will determine the criteria for placing students in appropriate mathematics courses.

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Placement Decision Considerations

- Placement in high school mathematics courses is dependent upon assessment of student knowledge from the transfer school.
- Students should be evaluated by a mathematics instructor with a thorough understanding of the content.
- After using the identified strengths to place the student in the appropriate course, identified weaknesses should be addressed through supplementary lessons that emphasize pre-requisite content knowledge. These lessons can be delivered through the mathematics support courses or through independent work.
- Students needing extensive remediation on middle grades topics should be considered for placement in **Foundations of Algebra**.
- Students requiring additional support for success in high school mathematics courses are best served through placement in **support courses concurrent with core course enrollment**.
- Students who exit high school having completed sequences through Algebra II or Advanced Algebra may have limited post-secondary options. Parents should be thoroughly advised of the consequences of their student graduating with only Algebra I through Algebra II credit or Coordinate Algebra through Advanced Algebra credit.
- During the advisement session, fourth year mathematics options should be discussed and clarified, and opportunities including summer courses, virtual courses, and other available resources explained.
- Students who will pursue post-secondary non-STEM study and have completed Algebra II or Advanced Algebra, but are still struggling with high school standards essential for success in first year post-secondary mathematics courses required for non-STEM majors, should be considered for enrollment in **College Readiness Mathematics** to meet the fourth mathematics core course graduation requirement.

Student Placement for Students Transferring into Georgia Schools from Out-of-State Schools

Because the *content* of courses with similar names can vary significantly, it is crucial that the transcripts of students entering Georgia high schools from other states or countries with existing credit in high school mathematics courses be examined and that the students' mathematics proficiency be assessed. In every case, students' transcripts should be carefully evaluated and compared to Georgia course content; placement assessments are appropriate as needed. Students' interest and levels of achievement (grades) should also be considered when making a placement decision.

Transfer Credit

Existing mathematics credits granted by out-of-state schools must be transferred as mathematics credit. Pursuant to State Board of Education Rule 160-5-1-.15 section (2)(a), "Local boards of education shall accept student course credit earned in an accredited school." In paragraph (2)(a)1, "A local board of education shall not substitute courses and exempt students from the required secondary minimum core curriculum...unless the student transferred from an accredited secondary school...". State Board of Education Rule 160-5-1-.15 AWARDING UNITS OF CREDIT AND ACCEPTANCE OF TRANSFER CREDIT AND/OR GRADES can be found at:

<http://www.gadoe.org/External-Affairs-and-Policy/State-Board-of-Education/SBOE%20Rules/160-5-1-.15.pdf>

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Military Transfer Law

In 2009, O.C.G.A. § 20-2-2130 through 20-2-2170 which pertain to the transfer and placement of children of military families in Georgia public schools were added to Georgia State Law. Among other provisions, the law requires that the local school system shall initially honor placement of the student in educational courses based on the student's enrollment in the sending state school or educational assessments conducted at the school in the sending state, if the courses are offered. Course placement includes but is not limited to honors, international baccalaureate, advanced placement, vocational, technical, and career pathways courses. Continuing the student's academic program from the previous school and promoting placement in academically and career challenging courses should be paramount when considering placement. Additionally, local school systems shall have flexibility in waiving course or program prerequisites or other preconditions for placement in courses and programs offered by the local school system.

Student Placement for Students Transferring out of Georgia Schools

Content descriptions (provided on pages 11-13) for all completed high school mathematics courses need to accompany transcripts of students transferring out of Georgia schools.

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Section 5: Mathematics Support Guidance for High School Students

We are dedicated to providing appropriate support for all students to ensure their successful completion of core academic high school mathematics coursework. The purpose of mathematics support courses is to address the needs of students who have traditionally struggled in mathematics by providing the additional time and attention they need.

The **Foundations of Algebra** course was developed to meet the needs of high school students who have completed mathematics in grades 6 – 8 yet will need **substantial** support to bolster success in high school mathematics. The course is aimed at students who have reported low standardized test performance in prior grades and/or have demonstrated significant difficulties in previous mathematics classes. Guidance for administrators and counselors in student selection can be accessed at the Georgia Department of Education Mathematics Program webpage <http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Pages/Mathematics.aspx>, including an administrator/counselor information video and a Monitoring Guidance document. Teacher resources for the course can be found at <https://www.georgiastandards.org/Common-Core/Pages/Math-9-12.aspx>. Students who successfully complete the course will be awarded one **core** mathematics credit.

Also available for **additional** and ongoing student support are **Mathematics Support** courses which are taught concurrently with a student's core academic mathematics course. Support courses are awarded elective credit. **Support courses can be retaken for additional elective credit if students retake core academic mathematics courses in which they were not initially successful and choose to retake the associated support course.**

How should students be selected to be enrolled in mathematics support courses?

Students who are *placed* in high school and have not passed middle school math state assessments should certainly be afforded the benefit of a support course. Other criteria might include teacher recommendation based on student performance in the previous or current mathematics course, prior retention, a failing grade in a mathematics course, and/or low scores on the mathematics component of state assessments, high school mathematics assessment, or other instruments used by the system to predict success.

Students are enrolled in **Foundations of Algebra** and/or **Mathematics Support Courses**, for Algebra I, Coordinate Algebra, Geometry, Analytic Geometry, Algebra II, and Advanced Algebra, based on local system criteria for identifying students who are at risk for failing mathematics.

Who should teach mathematics support courses?

Mathematics support courses should be taught by a certified mathematics teacher, preferably one with an understanding of growth mindset in mathematics and demonstrated experience in effectively differentiating instruction to meet the needs of struggling students. If English Learners are being served in a mathematics support course, it is recommended that the teacher also hold the ESOL endorsement. The mathematics support teacher should work closely with the teacher(s) teaching the associated core mathematics course to align content, instruction, and assessments

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How important is collaboration among teachers to the success of students enrolled in mathematics support courses?

Teachers of the mathematics support courses and the academic core mathematics courses, including collaborative English Learner (EL) and special education teachers, share the responsibility for students' mathematical achievement. In fact, all teachers who instruct students who are enrolled in mathematics support courses should consistently and frequently engage in communication which focuses on:

- individual student progress, including grades, strengths and weaknesses based on standards mastery, mathematical disposition, and work habits;
- curriculum expectations, including specific standards to be addressed based on a timeline, prerequisite skills, vocabulary, and potential misconceptions;
- instructional strategies, including specific strategies for teaching math concepts that are being used to provide consistency and understanding for teachers and students;
- differentiation of instruction;
- formative and summative assessments, including content and formats that are being used to evaluate students for specific standards.

What are the critical components of mathematics support courses?

- Students enrolled in **Foundations of Algebra** should be assessed frequently and appropriate interventions should be made available – the goal being readiness for Algebra I or Coordinate Algebra.
- The **Mathematics Support** course should focus on mastery of the standards being taught in the associated core academic mathematics course, and not on general content from elementary or middle school.
- All students in a particular **Mathematics Support** course should be enrolled in the same core academic mathematics course. (i.e., students enrolled in Coordinate Algebra Support will all be enrolled in Coordinate Algebra).
- Grading practices should emphasize mastery of standards through the frequent use of aligned quizzes and tests, both formative and summative.
- Continual progress monitoring should be used to assess and diagnose each student's strengths and weaknesses, based on the standards of the associated core academic mathematics course, and to provide appropriate interventions.
- Opportunities should be provided for students to review content with a focus on standards not previously mastered.
- Opportunities should be provided for students to preview the mathematical concepts associated with the subsequent or concurrent core academic mathematics course. Attention needs to be given to prerequisite skills and concepts and to the vocabulary of the current course.
- The academic language of mathematics should be explicitly taught as concepts are introduced and reinforced.
- Proven strategies for success in mathematics should be utilized on a daily basis. Students should be engaged in doing mathematics, explaining their thinking, and justifying their work. Multiple representations of concepts (tables, charts, graphs, verbal descriptions) should be used as often as possible.
- There should be strong emphasis on building a positive disposition toward learning mathematics.
- Although there is no class size requirement for the mathematics support courses, a reduced class size is recommended.

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○ **How will students be evaluated in mathematics support courses?**

The goal of a mathematics support course is to assist students in the successful completion of subsequent and/or associated core academic mathematics course. Assignments, quizzes and tests should be aligned to the standards being taught in Foundations of Algebra or in the associated core academic course. Individuals should be given multiple opportunities to show mastery of the content.

In Mathematics Support courses, opportunities to demonstrate mastery of material first addressed in the associated core academic mathematics course should be provided. Mathematics support provides the time some students need for additional practice or re-testing. The value of formative assessment and feedback cannot be overstated. Continuous progress monitoring with both feedback and commentary is essential in support courses. **Students should not feel pressure to “make grades” as much as they should be motivated and encouraged to master standards.** Documented continuous communication with students on an individual basis is the most appropriate way to maintain records of progress.

Will schools be able to receive Remedial Education Program (REP) for students enrolled in support courses?

REP can support funding for the Foundations of Algebra and Mathematics Support courses if REP guidelines for eligibility, scheduling, and class size are followed.

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Section 6: Resources Available to Middle School and High School Counselors

- Sandi Woodall, Mathematics Program Manager
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- Brooke Kline, Mathematics Secondary Specialist
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- GaDOE Mathematics Program Webpage
<http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Pages/Mathematics.aspx>
- GaDOE GeorgiaStandards.org Mathematics Website
<https://www.georgiastandards.org/Georgia-Standards/Pages/default.aspx>
- Staying On Course: University System of Georgia High School Curriculum Requirements
http://www.usg.edu/assets/student_affairs/documents/Staying_on_Course.pdf
- 2016-2017 State-Funded List of K-8 Subjects and 9-12 Courses
<https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Documents/State-Funded-List-of-Subjects-and-Courses-Supported-by-SBOE-Rule-160-4-2-20.pdf>
- Georgia High School Graduation Rule
<https://www.gadoe.org/External-Affairs-and-Policy/State-Board-of-Education/SBOE%20Rules/160-4-2-.48.pdf>
- Awarding Units of Credit and Acceptance of Transfer Credit and/or Grades Rule
[https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Documents/160-5-1-%2015%20Awarding%20Units%20of%20Credits%202-11-13%20posting%20\(3\).pdf](https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Documents/160-5-1-%2015%20Awarding%20Units%20of%20Credits%202-11-13%20posting%20(3).pdf)
- Guidelines for Awarding Units of Credit Rule
<https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Documents/Guidelines%20%20Awarding%20Units%20of%20Credit%20160-5-1-%2015%20%20%204-3-13%20with%20Appendices.pdf>
- SWD High School Mathematics Decision Rubric
<http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/Documents/SWD%20High%20School%20Mathematics%20Decision%20Rubric%209-22-16.pdf>