

High School Course Description: Mathematics

Starting as 9th graders, GISB students have already mastered a rigorous math curriculum throughout middle school that covers topics including: *Systems of linear equations* (substitution method, equalization method, elimination method, problems), *Quadratic function and quadratic equation* (definition and characteristics, vertex, vertex form, pq-formula, and ABC-formula, analyzing graphs, applying methods to real world scenarios), *solving basic probability problems*. They are able to translate mathematical information between different representations and were exposed to tasks that developed their communication and reasoning skills.

In our high school (as in all German high schools) the mathematics curriculum is based on the idea of a spiral curriculum. That is, every year we are circling back to a topic, deepening the complexity of the content each time.

There are three main content areas: Calculus, Vector Analysis, and Theory of Probability, which will be taught every year.

By the time they graduate, our students have mastered topics from the AP Calculus AB, AP Precalculus, and AP Statistics, with an additional emphasis on vector analysis. For a detailed list of what is covered each year in our intensive mathematics curriculum, please see below.

Grade 9

- Precalculus
 - Laws of exponents: similarities, dilation, intercept theorems
 - Curves, exponential growth, logarithms
- Trigonometry:
 - Sine, Cosine, Tangent
 - Determinations of triangles
 - Sine rule
 - Law of cosines

- Theorem of Pythagoras
- Geometry
 - Volume and area of geometric shapes
- Stochastics
 - Random variables, expected value, conditional probabilities

Grade 10

- *Functions:*
 - Power functions
 - Exponential functions
 - Trigonometric functions
- *Calculus of Probability:*
 - Statistics, diagrams, Bernoulli experiment
 - Tree diagram, product rule, adding-up rule
 - Expected value, standard deviation
 - Fourfold table
- *Vector Analysis:*
 - Vector, arithmetic laws
 - Equation of a line, relationships between two lines
- *Rate of Change and Derivative:*
 - Instantaneous and mean rate of change
 - Difference quotient, zeros
 - Monotonicity
 - Turning points

Grade 11

- *Derivatives:*
 - Definition, rule of derivation, chain rule, product rule
 - Higher derivatives
 - Turning points, point of inflection
 - Optimization problems
- *Polynomial Functions:*
 - Symmetry, end behavior, zeros, turning points, points of inflection
 - Tangents, determination of polynomial functions, family of curves
- *Integral Calculus:*
 - Definition, rule of integration
 - Fundamental theorem of calculus, area, volume of revolution
- *Vector Analysis:*

- Linearly dependent, linearly independent
- Magnitude
- Scalar product, cross product
- Equation of a line, equation of a plane, relationships, angles, distances

Grade 12

- Calculus of Probability I:
 - Combinatorics, product rule
 - Bayes' theorem, probability distribution
 - Expected value, variance, standard deviation, binomial distribution
- Exponential Functions:
 - Euler's number e , asymptotes, curve sketching
 - Integral, area, improper integral
- Rational Functions:
 - Vertical and oblique asymptotes, quotient rule, curve sketching, integral, area, improper integral
- Calculus of Probability II:
 - Probability of error, hypothesis test, confidence interval, normal distribution

Textbook / Informational Text Reading Amount:

Reading and problems the textbook listed below is assigned for homework or used in classroom in every class

- **Lambacher Schweizer 9-10, Mathematik für Gymnasien - Ausgabe Baden-Württemberg, Klett, 2015**
- **Lambacher Schweizer 9-10, Arbeitsheft, Mathematik für Gymnasien - Ausgabe Baden-Württemberg, Klett, 2017**
- **Lambacher Schweizer, Oberstufe, Mathematik für Gymnasien - Ausgabe Baden-Württemberg, Klett, 2015**

Types of Large Assessments in this Course:

Unit tests, quizzes, 2 x midterm exam (first semester), 2 x final exam (second semester)