MATHEMATICS MAJOR, B.S.

Mathematics has always been a fundamental component of human thought and culture, and the growth of technology in recent times has further increased its importance.

Students majoring in mathematics may enter either the B.A. or the B.S. program. The B.S. program is more comprehensive; it provides solid preparation for work or for further study in mathematics and related fields. Within the B.S. program there is an applied option, which is designed for students who are primarily interested in using mathematics for the study of other sciences. MATH 521 is a key class in the curriculum and MATH 381 is a key to prepare for it. The degree plan should be built with these classes as the backbone, and they should be taken in the second and third year by most students. Please see the sample plan for additional information and suggestions.

Student Learning Outcomes

Upon completion of the mathematics program (B.A., B.S.), students should be able to:

- Demonstrate mastery of the core of mathematics recognized as essential by national professional mathematics organizations
- Demonstrate mathematical reasoning and problem-solving skills
- Demonstrate the ability to construct logical arguments and mathematical proofs
- Demonstrate the ability to apply mathematical knowledge and skills in context and interpret results

In addition to the program requirements, students must

- earn a minimum final cumulative GPA of 2.000
- complete a minimum of 45 academic credit hours earned from UNC–Chapel Hill courses
- take at least half of their major core requirements (courses and credit hours) at UNC–Chapel Hill
- earn a minimum cumulative GPA of 2.000 in the major core requirements. Some programs may require higher standards for major or specific courses.

For more information, please consult the degree requirements section of the catalog (https://catalog.unc.edu/undergraduate/degree-requirements/).

Mathematics Major, B.S.

Code	Title	Hours
Core Requirements		
One of the following:		3
COMP 110	Introduction to Programming [H]	
COMP 116	Introduction to Scientific Programming	
STOR 120	Foundations of Statistics and Data Science [H, F]	4
or STOR 155	Introduction to Data Models and Inference	
MATH 347	Linear Algebra for Applications (preferably before the junior year; previously offered as MATH 547) [F]	3
or MATH 577	Linear Algebra	
MATH 381	Discrete Mathematics [1, H]	3
MATH 383	First Course in Differential Equations [H]	3
MATH 521	Advanced Calculus I [H]	3
One of the following:		3
MATH 522	Advanced Calculus II [H]	
MATH 523	Functions of a Complex Variable with Applications	
MATH 528	Mathematical Methods for the Physical Sciences I	
MATH 566	Introduction to Numerical Analysis	
One of the following:		3
MATH 533	Elementary Theory of Numbers	
MATH 534	Elements of Modern Algebra	
MATH 578	Algebraic Structures	
MATH 548	Combinatorial Mathematics	
At least three additional MATH courses numbered above 520, excluding MATH 528L and MATH 529L		9
Additional Requirements		
MATH 231	Calculus of Functions of One Variable I [H, F]	4
MATH 232	Calculus of Functions of One Variable II [H, F]	4
MATH 233	Calculus of Functions of Several Variables [H, F]	4
or MATH 235	Mathematics for Data Science	
Physics course chosen from the following options:		4
PHYS 118	Introductory Calculus-based Mechanics and Relativity (recommended) [H, F]	
PHYS 114	General Physics I: For Students of the Life Sciences [F]	
At least three additional courses in the Division of Natural Sciences and Mathematics		9
Remaining General Education requirements and enough free electives to accumulate 120 academic hours		61
Total Hours		**120**

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

F FY-Launch class sections may be available. A FY-Launch section fulfills the same requirements as a standard section of that course, but also fulfills the FY-SEMINAR/FY-LAUNCH First-Year Foundations requirement. Students can search for FY-Launch sections in ConnectCarolina using the FY-LAUNCH attribute.

1 A current or former major in statistics and analytics may substitute STOR 215 for MATH 381.

Mathematics Major, B.S.–Applied Option

Code	Title	Hours
Core Requirements		
COMP 110	Introduction to Programming [H]	3
or COMP 116	Introduction to Scientific Programming	
STOR 120	Foundations of Statistics and Data Science [H, F]	4
or STOR 155	Introduction to Data Models and Inference	
MATH 381	Discrete Mathematics [1, H]	3
MATH 383	First Course in Differential Equations [H]	3

MATH 521	Advanced Calculus I [H]	3
Five courses chosen from the following list: [2]		15
MATH 522	Advanced Calculus II [H]	
MATH 523	Functions of a Complex Variable with Applications	
MATH 524	Elementary Differential Equations	
MATH 528	Mathematical Methods for the Physical Sciences I [2]	
MATH 529	Mathematical Methods for the Physical Sciences II [2]	
MATH 535	Introduction to Probability	
MATH 548	Combinatorial Mathematics	
MATH 560	Optimization with Applications in Machine Learning [2]	
MATH 563	Introduction to Fluid Mechanics [2]	
MATH 564	Mathematical Modeling in the Life Sciences [2]	
MATH 566	Introduction to Numerical Analysis [2]	
MATH 661	Scientific Computation I [2]	
MATH 668	Methods of Applied Mathematics I [2]	
Sequence MATH 383L, MATH 528L, and MATH 529L [2]		
MATH 347	Linear Algebra for Applications [F]	3
or MATH 577	Linear Algebra	
Additional Requirements		
MATH 231	Calculus of Functions of One Variable I [H, F]	4
MATH 232	Calculus of Functions of One Variable II [H, F]	4
MATH 233	Calculus of Functions of Several Variables [H, F]	4
or MATH 235	Mathematics for Data Science	
Physics course chosen from the following options:		4
PHYS 118	Introductory Calculus-based Mechanics and Relativity (recommended) [H, F]	
PHYS 114	General Physics I: For Students of the Life Sciences [F]	
Strongly recommended:		
MATH 535/ STOR 435	Introduction to Probability	
STOR 555	Mathematical Statistics	
At least three additional courses in the Division of Natural Sciences and Mathematics.		9
Remaining General Education requirements and enough free electives to accumulate 120 academic hours		61
Total Hours		**120**

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

F FY-Launch class sections may be available. A FY-Launch section fulfills the same requirements as a standard section of that course, but also fulfills the FY-SEMINAR/FY-LAUNCH First-Year Foundations requirement. Students can search for FY-Launch sections in ConnectCarolina using the FY-LAUNCH attribute.

1 A current or former major in statistics and analytics may substitute STOR 215 for MATH 381.

2 with at least three from MATH 528, MATH 529, MATH 560, MATH 563, MATH 564, MATH 566, MATH 661, MATH 668, sequence MATH 383L + MATH 528L + MATH 529L.

Students must complete either the B.S. or B.S.-Applied Option for a B.S. degree with a major in mathematics. All requirements of the General Education curriculum (except for Supplemental General Education) apply to students in both options.

Following are suggested course selections (within the degree requirements) for students who have an interest in a particular direction.

Course Suggestions for Pure Mathematics

These courses provide a solid theoretical understanding of central mathematics and excellent preparation for graduate study in mathematics or the mathematical sciences.

Code	Title	Hours
MATH 521	Advanced Calculus I [H]	3
MATH 522	Advanced Calculus II [H]	3
MATH 577	Linear Algebra	3
MATH 578	Algebraic Structures	3
Enough upper-level mathematics courses to satisfy the degree requirements		

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

Those planning graduate study in mathematics or the mathematical sciences may consider taking some of MATH 653, MATH 676, MATH 680, or subsequent courses.

Course Suggestions for Mathematical Biology

For students interested in careers or further study in mathematical life sciences.

Code	Title	Hours
BIOL 101	Principles of Biology [H, F]	3
CHEM 101	General Descriptive Chemistry I [H, F]	3
or CHEM 102	General Descriptive Chemistry II	
At least one of:		4
BIOL 201	Ecology and Evolution [H]	
BIOL 202	Molecular Biology and Genetics [H, F]	
BIOL 205	Cellular and Developmental Biology [H]	
At least two of:		6
BIOL 454	Evolutionary Genetics	
BIOL 526	Computational Genetics [H]	
BIOL 551	Comparative Biomechanics	
BIOL 553	Mathematical and Computational Models in Biology	
MATH 521	Advanced Calculus I [H]	3
One of:		3
MATH 522	Advanced Calculus II [H]	
MATH 523	Functions of a Complex Variable with Applications	
MATH 528	Mathematical Methods for the Physical Sciences I	
MATH 566	Introduction to Numerical Analysis	

One of:		3
MATH 534	Elements of Modern Algebra	
MATH 548	Combinatorial Mathematics	
MATH 578	Algebraic Structures	
MATH 347 or MATH 577	Linear Algebra for Applications [F] / Linear Algebra	3
Three or more mathematics courses numbered above 500. Consider especially MATH 524, MATH 529, MATH 535, and MATH 564		9

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

F FY-Launch class sections may be available. A FY-Launch section fulfills the same requirements as a standard section of that course, but also fulfills the FY-SEMINAR/FY-LAUNCH First-Year Foundations requirement. Students can search for FY-Launch sections in ConnectCarolina using the FY-LAUNCH attribute.

Sample Plan of Study

Sample plans can be used as a guide to identify the courses required to complete the major and other requirements needed for degree completion within the expected eight semesters. The actual degree plan may differ depending on the course of study selected (second major, minor, etc.). Students should meet with their academic advisor to create a degree plan that is specific and unique to their interests. The sample plans represented in this catalog are intended for first-year students entering UNC–Chapel Hill in the fall term. Some courses may not be offered every term.

In the first two years, students are required to complete the standard calculus sequence, discrete mathematics, linear algebra, and first course in differential equations as well as introductory courses in computer science and physics. At the beginning of their third year, students take advanced courses in mathematics.

Mathematics Major, B.S.

First Year		Hours
First-Year Foundation Courses		
IDST 101	College Thriving	1
ENGL 105	English Composition and Rhetoric	3
First-Year Seminar or First-Year Launch (https://catalog.unc.edu/undergraduate/ideas-in-action/first-year-seminars-launches/) [F]		3
IDST 111L	Data Literacy Lab	1
Global Language through level 3 (https://catalog.unc.edu/undergraduate/ideas-in-action/global-language/)		varies
Major Courses		
COMP 110 or COMP 116	Introduction to Programming [H] or Introduction to Scientific Programming	3
Physics course chosen from the following options:		4
PHYS 118	Introductory Calculus-based Mechanics and Relativity (recommended) [H, F]	
PHYS 114	General Physics I: For Students of the Life Sciences [F]	
MATH 231	Calculus of Functions of One Variable I [H, F]	4
MATH 232	Calculus of Functions of One Variable II [H, F]	4
STOR 120 or STOR 115	Foundations of Statistics and Data Science [H, F] or Reasoning with Data: Navigating a Quantitative World	4
Hours		**27**
Sophomore Year		
MATH 233 or MATH 235	Calculus of Functions of Several Variables [H, F] or Mathematics for Data Science	4
MATH 381	Discrete Mathematics [1, 2, H]	3
MATH 383	First Course in Differential Equations [H]	3
MATH 347	Linear Algebra for Applications [F]	3
One of 3 courses in Division of Natural Sciences and Mathematics, but not in mathematics		3
Hours		**16**
Junior Year		
MATH 521	Advanced Calculus I [H]	3
MATH 522 or MATH 523 or MATH 528 or MATH 566	Advanced Calculus II [H] or Functions of a Complex Variable with Applications or Mathematical Methods for the Physical Sciences I or Introduction to Numerical Analysis	3
MATH 533 or MATH 534 or MATH 578 or MATH 548	Elementary Theory of Numbers or Elements of Modern Algebra or Algebraic Structures or Combinatorial Mathematics	3
One of 3 courses in Division of Natural Sciences and Mathematics, but not in mathematics		3
Hours		**12**
Senior Year		
At least 3 additional MATH courses numbered above 520, excluding MATH 528L and MATH 529L		9
One of 3 courses in Division of Natural Sciences and Mathematics, but not in mathematics		3
Hours		**12**
Total Hours		**67**

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

F FY-Launch class sections may be available. A FY-Launch section fulfills the same requirements as a standard section of that course, but also fulfills the FY-SEMINAR/FY-LAUNCH First-Year Foundations requirement. Students can search for FY-Launch sections in ConnectCarolina using the FY-LAUNCH attribute.

1 A current or former major in statistics and analytics may substitute STOR 215 (https://catalog.unc.edu/search/?P=STOR%20215) for MATH 381 (https://catalog.unc.edu/search/?P=MATH%20381).

[2] MATH 381 is a key course to prepare for MATH 521. Students with double majors should take MATH 381 over similar courses offered in other departments.

Mathematics Major, B.S.–Applied Option

First Year		Hours
First-Year Foundation Courses		
IDST 101	College Thriving	1
ENGL 105	English Composition and Rhetoric	3
First-Year Seminar or First-Year Launch (https://catalog.unc.edu/undergraduate/ideas-in-action/first-year-seminars-launches/) [F]		3
IDST 111L	Data Literacy Lab	1
Global Language through level 3 (https://catalog.unc.edu/undergraduate/ideas-in-action/global-language/)		varies
Major Courses		
COMP 110 or COMP 116	Introduction to Programming [H] or Introduction to Scientific Programming	3
Physics course chosen from the following options:		4
PHYS 118	Introductory Calculus-based Mechanics and Relativity (recommended) [H, F]	
PHYS 114	General Physics I: For Students of the Life Sciences [F]	
MATH 231	Calculus of Functions of One Variable I [H, F]	4
MATH 232	Calculus of Functions of One Variable II [H, F]	4
STOR 120 or STOR 155	Foundations of Statistics and Data Science [H, F] or Introduction to Data Models and Inference	4
Hours		**27**
Sophomore Year		
MATH 233 or MATH 235	Calculus of Functions of Several Variables [H, F] or Mathematics for Data Science	4
MATH 381	Discrete Mathematics [1, 4, H]	3
MATH 383	First Course in Differential Equations [H]	3
MATH 347	Linear Algebra for Applications [F]	3
One of 3 courses in Division of Natural Sciences and Mathematics, but not in mathematics [3]		3
Hours		**16**
Junior Year		
MATH 521	Advanced Calculus I [H]	3
Two of the five MATH elective courses (see list) [2]		6
One of 3 courses in Division of Natural Sciences and Mathematics, but not in mathematics [3]		3
Hours		**12**
Senior Year		
Three of the five MATH elective courses (see list) [2]		9
One of 3 courses in Division of Natural Sciences and Mathematics, but not in mathematics [3]		3
Hours		**12**
Total Hours		**67**

H Honors version available. An honors course fulfills the same requirements as the nonhonors version of that course. Enrollment and GPA restrictions may apply.

F FY-Launch class sections may be available. A FY-Launch section fulfills the same requirements as a standard section of that course, but also fulfills the FY-SEMINAR/FY-LAUNCH First-Year Foundations requirement. Students can search for FY-Launch sections in ConnectCarolina using the FY-LAUNCH attribute.

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2 with at least three from MATH 528, MATH 529, MATH 560, MATH 563, MATH 564, MATH 566, MATH 661, MATH 668, sequence MATH 383L + MATH 528L + MATH 529L.

3 These courses may be completed at any point in the major. However, we recommend starting early especially for sequential courses in another department. STOR 555 can be counted for this requirement and is strongly recommended.

4 MATH 381 is a key course to prepare for MATH 521. Students with double majors should take MATH 381 over similar courses offered in other departments.

Special Opportunities in Mathematics

Special activities for qualified students include an undergraduate Mathematics Club, problem-solving seminars, and the Putnam Mathematical Competition. Qualified students may pursue opportunities as undergraduate learning assistants or tutors in the Math Help Center. Students interested in these activities should consult the undergraduate student services manager for additional information.

Qualified students can conduct original research with the guidance of a faculty member, usually in conjunction with the preparation of an honors project. Study Abroad opportunities include semester or yearlong programs in a variety of countries. The Archibald Henderson Medal and the Alfred Brauer Prize recognize outstanding performance and promise in mathematics.

Undergraduate honors research projects as well as some internships or study abroad programs might qualify for research and discovery or experiential education credit in the General Education curriculum. MATH 296 satisfies this requirement.

Honors in Mathematics

Special honors (H) sections are given in some mathematics courses when student demand is sufficient (for example, MATH 62H, MATH 231H, MATH 232H, MATH 233H, MATH 381H, MATH 383H).

Promising students are encouraged to work toward a bachelor's degree with honors in mathematics. This program consists of nine or more courses approved by the departmental honors advisor and satisfactory completion of an honors project completed over the two semesters. The honors project is conducted in association with a departmental faculty member on a topic approved by the departmental honors advisor, and spans two semesters of independent research, during which time the honors candidate must be enrolled in MATH 691H and MATH 692H. The final report on the project includes both a written description and an oral presentation before a committee of three faculty (including the project advisor) approved by the departmental honors advisor. The committee

will then report to the departmental honors advisor, who, in conjunction with a subcommittee of the undergraduate committee, will make the final recommendation on awarding a degree with honors or highest honors. The candidate must have a 3.5 grade point average in mathematics courses to begin an honors project and must maintain the 3.5 average through the completion of the senior year.

UNC–BEST

The UNC Baccalaureate Education in Science and Teaching (UNC–BEST) Program is a collaboration between the School of Education and the College of Arts and Sciences and is designed to allow undergraduate mathematics (and science) majors interested in teaching high school mathematics the opportunity to earn their degree and obtain licensure as a North Carolina high school mathematics teacher in four years. For more details, see the School of Education (https://catalog.unc.edu/undergraduate/programs-study/best-minor/) section of the Catalog.

Department Programs

Majors

- Mathematics Major, B.A. (https://catalog.unc.edu/undergraduate/programs-study/mathematics-major-ba/)
- Mathematics Major, B.S. (p. 1)

Minor

- Mathematics Minor (https://catalog.unc.edu/undergraduate/programs-study/mathematics-minor/)

Graduate Programs

- M.A. in Mathematics (https://catalog.unc.edu/graduate/schools-departments/mathematics/)
- M.S. in Mathematics (https://catalog.unc.edu/graduate/schools-departments/mathematics/)
- Ph.D. in Mathematics (https://catalog.unc.edu/graduate/schools-departments/mathematics/)

Courses

- Mathematics (MATH) (https://catalog.unc.edu/courses/math/)

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