



**SAN FRANCISCO
STATE UNIVERSITY**

COLLEGE OF SCIENCE & ENGINEERING
DEPARTMENT OF PHYSICS & ASTRONOMY
1600 HOLLOWAY AVENUE
SAN FRANCISCO, CA 94132

Advising Guide for Undergraduate Physics & Astronomy

Last updated: April 19, 2022

Welcome to the Department of Physics & Astronomy within the College of Science & Engineering (CoSE) at San Francisco State University (SFSU)! We are an inclusive department where all students are welcome to study the cosmos!

Communicating with the department:

Main office: Thornton Hall 334

Email: physics@sfsu.edu (Though, it is better to directly email a specific person.)

Phone: 415-338-1659 (Though, it is better to directly email a specific person.)

The main office is staffed with the Department Chair and the Academic Office Coordinator (AOC).

Students should use their official sfsu.edu accounts for all university-related emails.

Information and news about the department can be found on our webpage and social media:

Department Website: <http://www.physics.sfsu.edu>

Department LinkedIn: <https://www.linkedin.com/company/sfsu-physics-astronomy>

Department Facebook: <https://www.facebook.com/sfsu.physics>

Faculty and staff frequently send email announcements about department, college, and university events, as well as scholarship and job opportunities. We automatically add all physics and astronomy majors to the department email lists, but we sometimes miss students. If you are not receiving regular emails from the department, please email physics@sfsu.edu.

Mission Statement:

"The fields of physics & astronomy use the scientific method to investigate the fundamental laws that govern the cosmos and all its contents, from subatomic particles to the cosmic web of galaxies on the largest observable scales in the universe and beyond. ***The pursuit of science is a human endeavor, and our department welcomes the full spectrum of humanity to contribute their perspectives, passions, and skills to scientific exploration.*** The mission of San Francisco State University's Department of Physics & Astronomy is to equip students from all backgrounds with foundational content knowledge in classical mechanics, electricity & magnetism, special & general relativity, thermodynamics & statistical mechanics, quantum mechanics, and astronomy & astrophysics; to provide "hands-on" training in theoretical, experimental, observational, and computational techniques for pure research and industrial and "real-world" applications; to mentor students to embrace an empirical, scientific framework to expand the boundaries of knowledge through novel research, and, ultimately, to create diverse STEM leaders, teachers, and policy-makers ready to tackle the most challenging problems facing society locally and globally."

Program Learning Outcomes:

Graduates with physics and astronomy degrees will be able to:

- PLO 1.) Describe universal physical principles in classical mechanics, electricity & magnetism, special & general relativity, thermodynamics & statistical mechanics, quantum mechanics, astronomy & astrophysics, and relate fundamental conservation principles (conservation of energy, conservation of linear momentum, conservation of angular momentum) to underlying symmetries of nature.
- PLO 2.) Analyze real-world physical systems on Earth and throughout the Universe, develop simplified models of such systems, translate physical principles into the language of mathematics, and then apply the appropriate mathematical tools (vector calculus, linear algebra, differential equations, variational techniques, probability & statistics, numerical & computational methods) to determine a system's spatiotemporal evolution with an awareness of the limitations of any solutions due to the approximations of the physical models and/or mathematical/computational techniques.
- PLO 3.) Demonstrate proficiency with basic laboratory skills and experimental techniques with electronics, lasers & optical devices, sensors, detectors, microscopes, and telescopes, always with appropriate safety practices (especially with respect to lasers, chemicals, radioactive materials).
- PLO 4.) Articulate and apply the “scientific method,” the empirical, iterative method of acquiring new knowledge through developing models to explain observations of the natural world, formulating testable hypotheses, designing and executing experimental, computational, and theoretical investigations to test predictions, analyzing data with appropriate statistics and attention to uncertainties, ascertaining consistency with existing theories, and sharing results with the broader scientific community for confirmation and validation.
- PLO 5.) Demonstrate writing, speaking, and visual data presentation skills to effectively communicate science at the appropriate level of sophistication for the relevant target audience (e.g., instructors, students, scientists, public-at-large, policy-makers).
- PLO 6.) Develop the social and communication skills to effectively participate in diverse scientific teams, including those that are multidisciplinary and/or interdisciplinary, and appreciate that the pursuit of science is a human endeavor and that progress is best made when the full spectrum of humanity is encouraged to participate and share their perspectives, passions, and skills.
- PLO 7.) Engage local, state, national & global communities to address current and emerging scientific and technological challenges in equitable and environmentally sustainable ways.

Which Degree?

We offer three Bachelor of Science (B.S.) options, two Bachelor of Arts (B.A.) options, and two minors:

B.S. Physics (71 units)	B.A. Physics (52 units)	Minor in Physics (24 units)
B.S. Physics w/ concentration in Astrophysics (71 units)	B.A. Physics w/ concentration in Astronomy (52 units)	Minor in Astronomy (19-23 units)
B.S. Physics w/ concentration in Physics for Teaching (64 units)		

The B.A. degrees are ideal for students who want a strong background in physical science but desire more flexibility to blend their curriculum with “liberal arts” and other interests. Students with B.A. degrees often pursue careers in teaching, science communication & journalism, science outreach (at science museums, planetaria & public observatories), medical, dental, and other health fields, or business sub-fields in which a rigorous scientific background is beneficial. The B.S. degrees require more in-depth technical training, advanced laboratory experiences, and specialized elective topics. Students with B.S. degrees often pursue science and engineering careers in colleges & universities, industrial research & development labs, or government labs & agencies, or pursue advanced graduate degrees in physics, astronomy, planetary science, or

engineering. The B.S. Physics, Concentration in Physics for Teaching allows for a very versatile curriculum that can be combined with Mathematics, Chemistry, or Earth & Climate Sciences to provide breadth across the physical sciences ideal for future K-12 teachers.

It is not unusual for students to switch between the degree options, even as late as the final year. To change majors, see the Registrar's website: https://registrar.sfsu.edu/change_major_minor

Advising & Planning:

Major Advisors: All physics & astronomy majors are assigned a faculty major advisor who will guide them on their academic journey. If you do not know who your major advisor is, please email the department at physics@sfsu.edu. New students (first-year & transfer students) should meet with their major advisor as soon as possible at the very start of their first semester at SFSU, or they may schedule a virtual appointment before the start of their first semester. Continuing students are required to meet with their major advisor in the fall semester before they will be allowed to register for classes for the following spring. Major advisors will help students with appropriate course selection and degree planning, advice on careers and graduate school, and help students identify any additional resources they may need. All students are encouraged to check-in as needed with their major advisor, especially if their academic plans change or if they are encountering any difficulties or obstacles.

CoSE Student Success Center: The CoSE Student Success Center (<https://cssc.sfsu.edu>) provides more general academic and pre-professional advising. They can provide guidance with general education (GE) requirements, university requirements, graduation checks, assistance with petitions and other forms, and referrals to other on-campus resources. The Student Success Center will work closely with students who are on academic probation to help them develop a comprehensive and holistic plan to get back on track with degree progress.

Degree Planning: There are a number of tools available to help students plan their academic programs.

- **Degree Roadmaps:** <http://www.physics.sfsu.edu/Academics/Undergrads.html>
Degree Roadmaps are suggested plans for completing degree requirements. While these are strong recommendations, students sometimes need to adjust them for their particular circumstances. Major advisors can advise you on any changes.
- **Degree Progress Report:** <https://registrar.sfsu.edu/dprguide>
You should spend time at the start and end of every semester reviewing your Degree Progress Report. This is the definitive record of your progress toward completing all degree requirements. Any substitutions need to be approved by a major advisor. If there are any errors, please immediately inform your major advisor.
- **Degree Planner:** <https://registrar.sfsu.edu/degreeplanner>
The Degree Planner is a tool that allows you to map out courses for future semesters and allows you to make adjustments for your particular circumstances.

Lower-Division Major Requirements:

All of the degrees in physics and astronomy have the same lower-division physics and math requirements. First-year students and sophomores should focus on completing calculus (MATH 226, 227, 228) and the introductory physics sequence (PHYS 220/222, 230/232, 240/242). Physics and math tracks are very hierarchical in that you must master one course before you can take the next course and many courses must be taken in a prescribed order. In order to make steady progress toward your degree, you should carefully plan your schedule; pay close attention to prerequisites and take courses in the right sequence.

It is absolutely imperative that you take a math course in your very first semester. Do not delay!

Which course you take depends on what your math preparation was prior to enrolling at SFSU. Students who have completed algebra and geometry and almost no or very little trigonometry will benefit from taking an extended two-semester pre-calculus sequence MATH 197 (Prelude to Calculus I) and MATH 198 (Prelude to Calculus II). Students who have completed intermediate algebra and some trigonometry can usually start with the one-semester version of pre-calculus MATH 199 (Pre-calculus). If you previously have done well (grade of B or better) in a solid pre-calculus course that included a significant amount of trigonometry, then you can dive right into the first course in the calculus sequence, MATH 226 (Calculus I).

The Dept. of Math has created a short online advising module to guide you to select the right starting course for you; see: mathadvising.sfsu.edu.

If your most advanced math class before SFSU was:	Then you should take this math course at SFSU:
H.S. introductory algebra and geometry and no trigonometry	MATH 197: Prelude to Calculus I, followed by MATH 198: Prelude to Calculus II
H.S. intermediate algebra and some trigonometry	MATH 197 & 198 (for more review/support), OR MATH 199: Pre-calculus (faster pace)
H.S. pre-calculus (including a significant amount of trigonometry) with a grade of B or better	MATH 226 (Calculus I)
A.P. Calculus AB with score of 4 or 5 (You earn 4 units of credit for MATH 226.)	MATH 227 (Calculus II)
A.P. Calculus BC with score of 5 overall AND 5 on AB subpart. (You earn 4 units of credit for MATH 227.)	MATH 228 (Calculus III) (Must meet with math advisor to get approval.)

A.P. Calculus Credit: If you took the A.P. Calculus AB exam and earned a score of 4 or 5, you are credited 4 units for MATH 226 and can proceed to MATH 227 (Calculus II). If you took the A.P. Calculus BC exam and earned a score of 5 overall **and** a score of 5 on the AB subpart, then you can meet with a math advisor to get approved for 4 units of MATH 227 and you can proceed to MATH 228 (Calculus III). Note that credit for MATH 227 is not automatic, you must meet with a math advisor.

Linear Algebra & Differential Equations: After you complete the three-semester calculus sequence through MATH 228, you should immediately move on to linear algebra and differential equations. You have a choice of MATH 245 (Elementary Differential Equations and Linear

Algebra), or a more in-depth, advanced two-semester sequence of MATH 325 (Linear Algebra) **and** MATH 376 (Ordinary Differential Equations). Note that MATH 325 will count for 3 units toward major electives. Students who intend to complete a math minor should definitely take the two-semester sequence (see Minor in Mathematics below).

Do Not Delay Starting the Physics Sequence: You should start the physics sequence immediately after completing MATH 226 with a grade of at least C (or passing an A.P. Calculus exam with a score of at least 4). The first course in the sequence is PHYS 220 (General Physics with Calculus I) and the corresponding 1-unit lab PHYS 222. Most students will then take PHYS 230/232, followed by PHYS 240/242. However, PHYS 240/242 can be taken at the same time or even before PHYS 230/232. This is especially relevant for students who may choose to take summer courses because PHYS 230/232 are offered in the summer session, but PHYS 240/242 are not (at least not at SFSU, but perhaps at some community colleges). Note that PHYS 230/232 and PHYS 240/242 both require previous completion of MATH 227 with a grade of C or better (or A.P. Calculus BC with a score of 5).

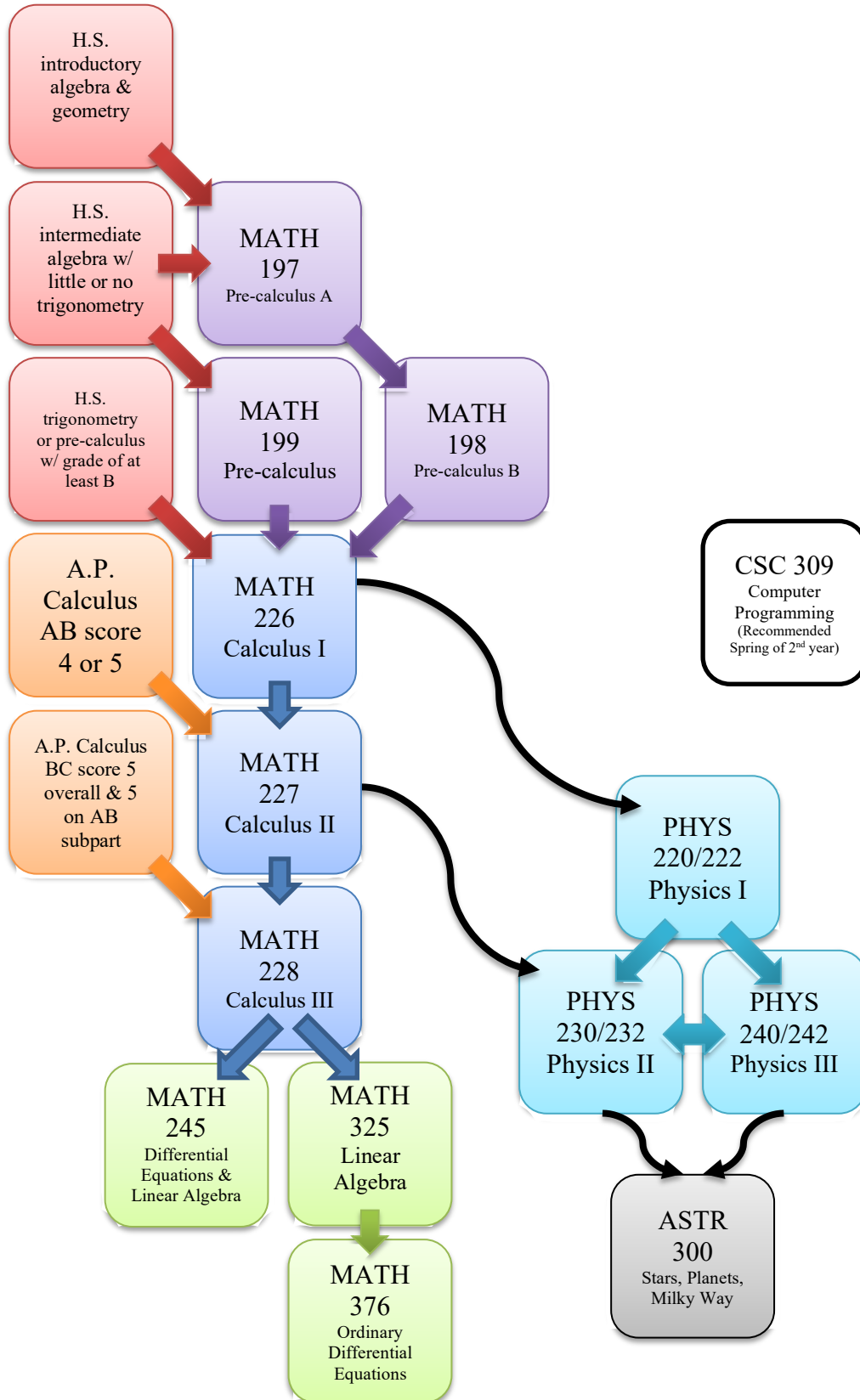
A.P. Physics Credit: Students who earn a score of 4 or 5 on the A.P. Physics C: Mechanics exam are credited with 4 units for PHYS 220/222. Students who earn a score of 4 or 5 on the A.P. Physics C: Electricity & Magnetism exam are credited with 4 units for PHYS 230/232. Note that the A.P. Physics 1 & 2 do not earn any credit toward Physics/Astronomy degrees at SFSU.

Computer Science: The B.S. Physics and the B.S. Physics concentration in Astrophysics both require CSC 309 (Computer Programming), but students in other physics & astronomy degrees are strongly encouraged to take it as well. Students should complete this course within their first two years because upper-division physics and astronomy courses may require computer programming on some assignments. Currently, CSC 309 teaches Python programming.

Beginning the astronomy and astrophysics concentrations: The B.A. Physics with concentration in Astronomy requires ASTR 115: Introduction to Astronomy. There is an optional 1-unit lab ASTR 116: Astronomy Laboratory. ASTR 115 gives a broad, descriptive survey of all of astronomy with very little math or physics. This course should be taken in the first two years. While ASTR 115 is *not* required for the B.S. Physics with concentration in Astrophysics, B.S. students benefit from the overview of astronomy (however, the units do not count toward the B.S. degree).

ASTR 300: Stars, Planets, and the Milky Way is the first astronomy course that uses significant math and physics. B.A. and B.S. students should take this course in the spring semester immediately following completion of PHYS 230 & 240. Students who want to take ASTR 300 concurrently with PHYS 230 or 240 should consult the instructor. ASTR 301: Observational Astronomy Laboratory is usually taken in the fall semester of junior year. Students with sufficient preparation may take it earlier with permission of the instructor.

SFSU Lower-Division Calculus & Physics Sequences



Lower-Division Tracks:

In the first two years, students should plan to take 5 courses per semester. Every course should count for either a major requirement or a General Education requirement.

Starting with MATH 226: Calculus I

First Year Fall	First Year Spring	Second Year Fall	Second Year Spring
MATH 226 (4)	MATH 227 (4)	MATH 228 (4)	MATH 245 or 325 (3)
ASTR 115 (3) or GE (3)	PHYS 220/222 (4)	PHYS 230/232 (4)	PHYS 240/242 (4)
GE (3)	CSC 309 (3)	GE (3)	ASTR 300 (3) or GE (3)
GE (3)	GE (3)	GE (3)	GE (3)
GE (3)	GE (3)	GE (3)	GE (3)

Notes: ASTR 115 is required only for B.A. Physics w/ concentration in Astronomy and can be taken any semester in first two years. ASTR 300 is required only for B.A. Physics w/ concentration in Astronomy and B.S. Physics w/ concentration in Astrophysics. All students are strongly encouraged to complete CSC 309 in first two years. Students completing Minor in Math should take MATH 325 instead of MATH 245, and then take MATH 376 in fall semester of third year.

Starting with MATH 199: Pre-calculus, Summer 1 → 2 catch-up

First Year Fall	First Year Spring	Summer 1 → 2	Second Year Fall	Second Year Spring
MATH 199 (4)	MATH 226 (4)	MATH 227 (4)	MATH 228 (4)	MATH 245 or 325 (3)
GE (3)	ASTR 115 (3) or GE (3)	PHYS 220/222 (4)	PHYS 230/232 (4)	PHYS 240/242 (4)
GE (3)	GE (3)		GE (3)	CSC 309 (3)
GE (3)	GE (3)		GE (3)	ASTR 300 (3) or GE (3)
GE (3)	GE (3)		GE (3)	GE (3)

Notes: ASTR 115 is required only for B.A. Physics w/ concentration in Astronomy and can be taken any semester in first two years. ASTR 300 is required only for B.A. Physics w/ concentration in Astronomy and B.S. Physics w/ concentration in Astrophysics. All students are strongly encouraged to complete CSC 309 in first two years. Students completing Minor in Math should take MATH 325 instead of MATH 245, and then take MATH 376 in fall semester of third year.

Starting with MATH 199: Pre-calculus, Summer 2 → 3 catch-up

First Year Fall	First Year Spring	Second Year Fall	Second Year Spring	Summer 2 → 3
MATH 199 (4)	MATH 226 (4)	MATH 227 (4)	MATH 228 (4)	MATH 245 or 325 (3)
GE (3)	ASTR 115 (3) or GE (3)	PHYS 220/222 (4)	PHYS 240/242 (4)	PHYS 230/232 (4)
GE (3)	GE (3)	GE (3)	CSC 309 (3)	
GE (3)	GE (3)	GE (3)	ASTR 300 (3) or GE (3)	
GE (3)	GE (3)	GE (3)	GE (3)	

Notes: PHYS 240/242 is not offered over summer, but PHYS 230/232 is, so in this plan, the order is switched. ASTR 115 is required only for B.A. Physics w/ concentration in Astronomy and can be taken any semester in first two years. ASTR 300 is required only for B.A. Physics w/ concentration in Astronomy and B.S. Physics w/ concentration in Astrophysics. All students are strongly encouraged to complete CSC 309 in first two years. Students completing Minor in Math should take MATH 325 instead of MATH 245, and then take MATH 376 in fall semester of third year.

Starting with MATH 199: Pre-calculus, Intensive second year spring

First Year Fall	First Year Spring	Second Year Fall	Second Year Spring
MATH 199 (4)	MATH 226 (4)	MATH 227 (4)	MATH 228 (4)
GE (3)	CSC 309 (3)	PHYS 220/222 (4)	MATH 245 or 325 (3)
GE (3)	ASTR 115 (3) or GE (3)	GE (3)	PHYS 230/232 (4)
GE (3)	GE (3)	GE (3)	PHYS 240/242 (4)
GE (3)	GE (3)	GE (3)	ASTR 300 (3) or GE (3)

Notes: ASTR 115 is required only for B.A. Physics w/ concentration in Astronomy and can be taken any semester in first two years. ASTR 300 can be taken in second year spring or delayed until third year spring. All students are strongly encouraged to complete

CSC 309 in first two years. Students completing Minor in Math should take MATH 325 instead of MATH 245, and then take MATH 376 in fall semester of third year.

Starting with MATH 197: Prelude to Calculus I, first 3 years of 5-year plan

First Year Fall	First Year Spring	Second Year Fall	Second Year Spring	Third Year Fall	Third Year Spring
MATH 197 (3)	MATH 198 (3)	MATH 226 (4)	MATH 227 (4)	MATH 228 (4)	MATH 245 or 325 (3)
GE (3)	GE (3)	ASTR 115 (3) or GE (3)	PHYS 220/222 (4)	PHYS 230/232 (4)	PHYS 240/242 (4)
GE (3)	GE (3)	GE (3)	CSC 309 (3)	GE (3)	ASTR 300 (3) or GE (3)
GE (3)	GE (3)	GE (3)	GE (3)	GE (3)	

Notes: ASTR 115 is required only for B.A. Physics w/ concentration in Astronomy and can be taken any semester in first two years. ASTR 300 is required only for B.A. Physics w/ concentration in Astronomy and B.S. Physics w/ concentration in Astrophysics. All students are strongly encouraged to complete CSC 309 in first two years. Students completing Minor in Math should take MATH 325 instead of MATH 245, and then take MATH 376 in fall semester of third year.

Starting with MATH 197: Prelude to Calculus I, attend summer sessions to catch-up

First Year Fall	First Year Spring	Summer 1 → 2	Second Year Fall	Second Year Spring	Summer 2 → 3
MATH 197 (3)	MATH 198 (3)	MATH 226 (4)	MATH 227 (4)	MATH 228 (4)	MATH 245 or 325 (3)
GE (3)	GE (3)	GE (3)	PHYS 220/222 (4)	PHYS 240/242 (4)	PHYS 230/232 (4)
GE (3)	GE (3)		ASTR 115 (3) or GE (3)	ASTR 300 (3) or GE (3)	
GE (3)	GE (3)		GE (3)	CSC 309 (3)	
GE (3)	GE (3)		GE (3)	GE (3)	

Notes: PHYS 240/242 is not offered over summer, but PHYS 230/232 is, so in this plan, the order is switched. ASTR 115 is required only for B.A. Physics w/ concentration in Astronomy and can be taken any semester in first two years. ASTR 300 is required only for B.A. Physics w/ concentration in Astronomy and B.S. Physics w/ concentration in Astrophysics. All students are strongly encouraged to complete CSC 309 in first two years. Students completing Minor in Math should take MATH 325 instead of MATH 245, and then take MATH 376 in fall semester of third year.

Upper-Division Major Requirements:

The following are recommended plans for completing upper-division degree requirements. Students can make adjustments for their individual circumstances, but should pay close attention to prerequisites and when courses are offered. Note that upper-division required core courses are usually only offered once per year, and many major electives are only offered every other year. Courses in bold should be taken in the indicated semester to keep on track.

B.S. Physics

Junior Fall	Junior Spring	Senior Fall	Senior Spring
PHYS 320 (3)	PHYS 360 (3)	PHYS 430 (3)	Major elective (5)
PHYS 321 (2)	PHYS 370 (3)	PHYS 460 (3)	Major elective (5)
PHYS 330 (3)	PHYS 457 (4)	PHYS 490 (3)	GE UD (3)
PHYS 385 (3)	GE UD (3)	PHYS 695 (1)	GE UD (3)

Notes: If a student has not yet taken differential equations (MATH 245 or 376), they must do so in junior fall; such students may choose to delay PHYS 330 to senior fall. Students who have not taken CSC 309 in a previous year must take it in junior year. PHYS 370 and 457 can be taken in either junior spring or senior spring. In years when PHYS 457: Analog Electronics is not offered, students may substitute ENGR 205/206: Electric Circuits (offered in fall or spring). Starting in Fall 2022, PHYS 490 (2 units) & PHYS 491 (1 unit) will be combined into PHYS 490 (3 units).

B.S. Physics/Astrophysics

Junior Fall	Junior Spring	Senior Fall	Senior Spring
ASTR 301 (2)	PHYS 360 (3)	PHYS 430 (3)	PHYS 370 (3)
PHYS 320 (3)	ASTR 300 (3)	ASTR 400 (3)	Major elective (6)
PHYS 330 (3)	ASTR 340 (3)	ASTR 697 (3)	GE UD (3)
PHYS 385 (3)	ASTR 470 (3)**	GE UD (3)	GE UD (3)

Notes: If a student has not yet taken differential equations (MATH 245 or 376), they must do so in junior fall; such students may choose to delay PHYS 330 to senior fall. Students who have not taken CSC 309 in a previous year must take it in junior year. PHYS 370 and ASTR 340 can be taken in either junior spring or senior spring. **ASTR 470 is only offered every other year, so a student must take it in junior spring if it is offered. ASTR 697: Senior Project can be taken in either senior fall or senior spring, or even split across both semesters. Students who are completing more intensive projects may take ASTR 697 for up to 6 units, counting 3 units toward major electives. Students may substitute another major elective if they choose not to do a senior project.

B.S. Physics/Teaching

Junior Fall	Junior Spring	Senior Fall	Senior Spring
PHYS 320 (3)	PHYS 360 (3)	PHYS 490 (3)	EED 655 (3)
PHYS 321 (2)	PHYS 370 (3)	PHYS 695 (1)	Major elective (4)
PHYS 330 (3)	Major elective (3)	Major elective (3)	GE UD (3)
PHYS 385 (3)	GE UD (3)	Major elective (3)	GE UD (3)

Notes: If a student has not yet taken differential equations (MATH 245 or 376), they must do so in junior fall; such students may choose to delay PHYS 330 to senior fall. EED 655: Hands-on Undergraduate Science Education Experience can be taken in fall or spring of junior or senior year. It is recommended that students choose major electives in such a way as to complete a minor in another STEM field, such as Mathematics, Chemistry, or Earth & Climate Sciences, or to expand breadth across many other science fields. Starting in Fall 2022, PHYS 490 (2 units) & PHYS 491 (1 unit) will be combined into PHYS 490 (3 units). CSC 309: Computer Programming is strongly encouraged (can count as major elective).

B.A. Physics

Junior Fall	Junior Spring	Senior Fall	Senior Spring
PHYS 320 (3)	PHYS 360 (3)	PHYS 490 (3)	Major elective (3)
PHYS 321 (2)	PHYS 370 (3)	PHYS 695 (1)	Major elective (1)
PHYS 330 (3)	GE UD (3)	GE UD (3)	GE UD (3)
PHYS 385 (3)			

Notes: If a student has not yet taken differential equations (MATH 245 or 376), they must do so in junior fall; such students may choose to delay PHYS 330 to senior fall. Starting in Fall 2022, PHYS 490 (2 units) & PHYS 491 (1 unit) will be combined into PHYS 490 (3 units). CSC 309: Computer Programming is strongly encouraged (can count as major elective).

B.A. Physics/Astronomy

Junior Fall	Junior Spring	Senior Fall	Senior Spring
PHYS 320 (3)	ASTR 300 (3)	PHYS 695 (1)	Major Elective (3)
PHYS 321 (2)	ASTR 340 (3)	Major elective (5)	GE UD (3)
ASTR 301 (2)	ASTR 470 (3)**	GE UD (3)	GE UD (3)

Notes: Students are strongly encouraged to take MATH 245: Elementary Differential Equations & Linear Algebra because it is a prerequisite for many upper-division physics & astronomy courses. (We plan to soon make this a requirement.) CSC 309: Computer Programming is also strongly encouraged. Both MATH 245 & CSC 309 count as major electives. **ASTR 470 is only offered every other year, so a student must take it in junior spring if it is offered.

Want to be a “Learning Assistant”? An LA is a special peer-tutor who assists instructors in the lower-division introductory physics and astronomy classes. First-time LAs take a 1-unit seminar PHYS 685: Instructional Methods in Teaching Physics and get an additional 1-unit for PHYS 686: Experiences in Teaching Physics. Students who continue as LAs in subsequent semesters need only take PHYS 686. For more information, contact Prof. Kim Coble (kcoble@sfsu.edu), who is the Director of the Learning Assistant Program.

Consider peer-teaching through the Supplemental Instruction (SI) program: Supplemental Instructors (SIs) are paired-up to co-teach 1-unit Supplemental Instruction classes in math, physics, chemistry, biology, and computer science. SIs prepare their own lesson plans (in consultation with professors and lecturer faculty) to help students with science concepts and problem-solving skills. SIs are paid positions. For more information, contact Jessica Fielder (jfielder@sfsu.edu), who is the Director of the Supplemental Instruction Program.

Special astronomy opportunities and electives: Students who have completed ASTR 115 or ASTR 300 may participate in the Planetarium Workshop and receive 1 unit of major elective credit via ASTR 685: Projects in the Teaching of Astronomy. Beginning and advanced workshops are offered in alternating semesters depending on interest and demand. Students who have completed ASTR 301 may volunteer as Observatory Docents and receive 1 unit of major elective credit via ASTR 685: Projects in the Teaching of Astronomy. Students at all levels are invited to participate in Monday Night Leuschner Workshops, run by staff member Jim Gibson (jimg@sfsu.edu) in which students learn to take and analyze data with the 30-inch Leuschner telescope, which is remotely controlled from Thornton Hall. Students who have completed ASTR 301 are also eligible to do independent-study projects using Leuschner. See details about these facilities below and consult Prof. Adrienne Cool (cool@sfsu.edu) for further information.

Electives outside PHYS/ASTR: Certain upper-division classes in other STEM fields can count as major electives. The department maintains a list of these courses on the department website; see: <http://www.physics.sfsu.edu/Academics/Courses.html>.

Graduate classes: Seniors who have earned grades of at least B in most of their required upper-division coursework may obtain permission from instructors to take graduate-level (numbered 700 and above) physics and astronomy courses. If these graduate classes are “extra” and not needed as major electives to complete the undergraduate degree, then the student may transfer them over to the M.S. degree if they subsequently enter the graduate program. This is a great way for advanced seniors to get a jump-start on the M.S. degree!

Minor in Mathematics: Students who want a more rigorous math background should choose MATH 325 & 376 instead of MATH 245. MATH 325 is offered in fall, spring, and summer, while MATH 376 is only offered in fall, and may be taken concurrently with PHYS 330 & 385. The units for MATH 325 can go toward major electives. The Math Department will allow either PHYS 430 or PHYS 460 to count toward the Minor in Mathematics – that means Physics majors will only need ONE more math class to complete the Minor in Mathematics! Recommended courses include: MATH 380: Complex Analysis, MATH 400: Numerical Analysis, MATH 440: Probability &

Statistics I, MATH 450: Topology, MATH 451: Differential Geometry, and MATH 477: Partial Differential Equations.

Office Hours: Every instructor has a few hours per week designated as “office hours” in which students are strongly encouraged to attend to get help with their courses, or to get advice on graduate school and careers, or just to talk about science and life! Go to office hours! Your instructors really do want to help you.

Minors in Physics and Astronomy: The department offers two minors, a Minor in Physics (24 units) and a Minor in Astronomy (19-23 units). Note that physics majors are not allowed to complete the astronomy minor (university rules prohibit minors in the same department as the major).

Summer & winter sessions: Major requirements that are offered over the summer include ASTR 115, MATH 226, 227, 228, 245, 325, PHYS 220/222, 230/232. Note that PHYS 240/242 are not typically offered during the summer, at least at SFSU (though they may be offered at some other CSU campuses or community colleges). The department does not currently offer any courses over the short winter intersession. Note that summer session and winter intersession are great times to catch-up on General Education requirements.

Check your Degree Progress Report (DPR) regularly! This is the official record of your progress toward your degree. Please email the Department Chair to correct any discrepancies in the DPR (for example, if a transfer course is not being correctly matched with a requirement).

Substitutions: There are times when a student cannot satisfy a particular degree requirement without significantly delaying degree progress, or when a student has a very strong reason for wanting to substitute one required course with some other course. We want to help you stay on track with your degree and are open to well-justified requests for course substitutions. Please discuss any possible substitutions with your major advisor first. All substitutions will need final approval of the Department Chair.

Academic Integrity:

Academic integrity is honesty in the demonstration and presentation of your effort and achievement in all academic pursuits. You are expected to present your own work on homework assignments, quizzes, exams, papers, and projects. However, science is collaborative and we encourage the discussion of and sharing of ideas. So, what is the boundary between collaboration and cheating?

Acceptable collaboration	Academic dishonesty
With respect to homework and problem sets, discussing fundamental concepts and general problem-solving strategies with classmates is encouraged...	But copying solutions from classmates, or dividing up homework problems and swapping solutions is considered cheating.
Using the internet to look for example problems for practice is acceptable...	But using the internet to look for solutions to specific homework problems, or looking for solution manuals online is considered cheating.
Using tutorial and self-study websites such as Khan Academy to review concepts and problem-solving strategies is encouraged...	But posting homework, quiz, and exam problems to cheating websites (e.g. Chegg, CourseHero, Yahoo Answers) to solicit solutions is absolutely considered cheating.
Having a friend proofread a paper (and make suggestions), or going to the tutoring center to get help with writing or editing a paper is acceptable...	But copying a paper, or downloading a paper, or soliciting others to write (or edit and rewrite) a paper for you is absolutely considered cheating. Also, re-using a paper from a previous class, or using a paper for two classes in the same semester is considered cheating unless you get explicit permission from the instructors (generally, they will expect a longer, more in-depth paper).
Referencing other work with proper use of quotation and citation of sources is encouraged...	But copying sentences or paragraphs without proper quotation or citation of sources is considered plagiarism or cheating.

The above list is not exhaustive, but only representative of common situations. Always ask yourself: *“Is the work I am presenting representing my own research, effort, ideas, or am I trying to pass off others’ intellectual efforts as my own?”* When in doubt, ask your instructors! They will be happy to advise and guide you! We are aware that there may be situations in which you are genuinely unsure of what is acceptable or not.

Check out MIT’s website on “Academic Integrity”: <https://integrity.mit.edu>

Anti-discrimination Policy:

In the mission statement of the department, we state: *“The pursuit of science is a human endeavor, and our department welcomes the full spectrum of humanity to contribute their perspectives, passions, and skills to scientific exploration.”*

The Department of Physics & Astronomy will not tolerate any behaviors or actions from faculty, staff, and students that has negative impact on the educational & professional opportunities of any member of the department. Discrimination on the basis of race, ethnicity, nationality, religion, sex, sexual orientation, gender, gender identity, gender expression, marital status, medical condition, genetic information, veteran or military status, is strictly prohibited.

Please pay close attention to the official SFSU “Nondiscrimination Policy and Complain Procedures:” <http://bulletin.sfsu.edu/policies-procedures/regulations-procedures/nondiscrimination-policy/>

Activities, Programs, Groups, and Other Resources

Physics & Astronomy Colloquium:

The Physics & Astronomy Colloquium (<http://www.physics.sfsu.edu/Colloquia.html>) is a weekly seminar series in which we invite professors and researchers from other institutions to share their cutting-edge research. Seminars are on most Mondays during the academic year, 3:30-4:45 PM. Students are invited to a students-only lunch-time conversation with the invited speaker, 12:30-1:45 PM.

Physics & Astronomy Computer Rooms:

The department maintains two computer rooms for use by physics & astronomy majors. Thornton Hall 123 has a number of Windows PCs and a printer. Students also use this room as a study space. Trailer O2 has a dozen Apple iMacs. The computers have a suite of standard software (Microsoft Office, MATLAB, Mathematica, etc.).

Tutoring & Academic Support Center (TASC):

TASC (<https://tutoring.sfsu.edu>) provides individual and group tutoring for a variety of classes. TASC also hires students to be peer tutors.

Cal-Bridge:

Cal-Bridge is a special scholarship & mentoring program for CSU undergraduates in certain STEM disciplines, including physics & astronomy, who are interested in exploring the possibility of pursuing a PhD. It is a 2-year program and students can only apply at the end of the spring semester before their second-to-last year. The program provides: scholarships up to \$5000 per semester for the final two years, depending on financial need; mentoring from two mentors, one from their CSU campus and another from a University of California campus; monthly workshops on academic & professional skills development; and intensive support in applying to graduate programs. For more information, check-out: <https://www.cpp.edu/calbridge>.

Scholarships:

Many department, college, and university scholarships have deadlines in the spring semester. SFSU's website for scholarships is <https://sfsu.academicworks.com>. Here, you can search a database for scholarships offered through the university. This is also where you submit applications. Scholarships that are specifically for physics and astronomy majors include:

- **Michael & Greta McKinney Physics & Astronomy Scholarship:** 1-3 scholarships of \$2000-\$5000, awarded to rising senior physics and astronomy majors for academic excellence and/or improvement, participation in research, and service & leadership in the department. Students must demonstrate financial need.
- **Dennis Bennett Physics & Astronomy Scholarship:** 1-3 scholarships of \$1000-\$2000, awarded to undergraduate physics and astronomy majors of any level. Students must demonstrate financial need.
- **Bengier Foundation University Scholarship:** one \$3000 scholarship awarded to a physics OR math major. Students must demonstrate financial need.
- **Eden Academic Excellence Awards:** multiple \$2000 scholarships awarded to B.S. Physics or B.S. Chemistry majors who earns at least 3 grades of B+ or better in a specific list of upper-division physics and chemistry courses. No application is required. Department determines eligibility for all rising seniors. (Note: B.A. Physics, B.A. Physics w/ concentration in Astronomy, B.S. Physics w/ concentration in Astrophysics, and B.S. Physics w/ concentration in Physics for Teaching are *not* eligible.)

PAC & WIPAA:

We have two very active student groups: the Physics & Astronomy Club (PAC, sfsupac@gmail.com) and Women in Physics and Astronomy (WIPAA, wipaa@mail.sfsu.edu). They sponsor various academic and social events throughout the year.

The groups share a "clubroom" located in Thornton 115. There is a library of physics & astronomy textbooks. There are designated "quiet hours" when students use the room to study, and the rest of the time is free for hanging-out and socializing.

Get involved! Check them out on social media:

- Physics & Astronomy Club (PAC) Facebook:
<https://www.facebook.com/groups/PAC.SFSU>
- Women in Physics and Astronomy (WIPAA) Facebook:
<https://www.facebook.com/WIPAAfsu>

Astronomers for Planet Earth (Astro4Earth):

Astro4Earth is a grass-roots movement uniting astronomy students, educators, and scientists around the globe to share their astronomical perspective about the Earth and climate change with the public. It was co-founded by students and faculty at SFSU and Yale University in Fall 2019.

Astronomers have detected thousands of planets orbiting other stars. We study the attributes that make a planet habitable and we search for life on other worlds. However, potentially habitable worlds are more than 25,000,000,000,000 miles away. We can learn much from our discoveries of remote planets but, as noted by [2019 Nobel Laureate, Michel Mayor](#), we cannot travel to them. We must take care of Earth. There is no Planet B.

Learn more and get involved:

Astro4Earth website: <https://astronomersforplanet.earth>

Astro4Earth on Facebook: <https://www.facebook.com/astro4earth>

Astro4Earth on Twitter: <https://twitter.com/Astro4Earth>

Astro4Earth on LinkedIn: <https://www.linkedin.com/company/astronomers-for-planet-earth/>

Astro4Earth on Instagram: <https://www.instagram.com/astro4earth/>

The SFSU Roof-top Observatory, Planetarium, and Leuschner Observatory

The SFSU Roof-top Observatory (<http://www.physics.sfsu.edu/observatory/>) is a student-run facility open to all students, staff, and to members of the public two or three nights per week during the school year, when skies are clear. With the aid of observatory docents, visitors use the telescopes to look at craters on the Moon, the rings of Saturn, giant star clusters, nebulae created by dying stars, the Andromeda galaxy, and much more. Need a study break? Come on by, and bring a friend! Physics & Astronomy majors who would like to volunteer as docents should contact Prof. Adrienne Cool (cool@sfsu.edu). Students may earn major elective credit via ASTR 685: Projects in the Teaching of Astronomy.

The Charles F. Hagar Planetarium (<http://www.physics.sfsu.edu/planetarium/>) opened its doors in 1973. Since that time, we have served an estimated 100,000 visitors, including SFSU students, San Francisco school children, community groups, and members of the general public. We have also trained and mentored hundreds of undergraduate and graduate students interested in planetarium operations and science education and outreach. Many have gone on to careers in education in the Bay Area, California, and beyond. All of our offerings are free and the planetarium is wheelchair accessible.

SFSU operates the 30-inch telescope at **Leuschner Observatory** in Lafayette, CA jointly with UC Berkeley (<http://www.physics.sfsu.edu/observatory/leuschner.html>). The telescope is equipped with a high-quality CCD camera and is run remotely from a control room in Thornton Hall. Students can take data and learn to analyze them during Monday Night Leuschner Workshops led by staff member Jim Gibson (jimg@sfsu.edu).

Research Experiences for Undergraduates (REUs):

REUs are paid summer internships sponsored by the National Science Foundation (NSF) and hosted at various colleges, universities, research institutions, and government laboratories throughout the country. There are also similar non-NSF summer science internships sponsored by universities and research institutions. Applications are generally due in January and February. REUs pay a fixed stipend (usually around \$5000) and often also pay for air travel to/from the site, room & board (usually in dorms), and even travel to a later conference to present your work.

REUs are an outstanding way to get experience *doing* science, and your participation will look great on resumes and/or graduate school applications. The NSF maintains a website with an extensive list of opportunities: https://www.nsf.gov/crssprgm/reu/reu_search.jsp.

CSU students are especially encouraged to apply to CAMPARE, which is an affiliated network of REUs. With CAMPARE, you can apply to dozens of REUs with only one common application. Check out: <https://www.cpp.edu/calbridge/summer-research/index.shtml>.

Note that you can apply to REUs in science fields outside your major. So be sure to look at opportunities in engineering or geoscience to expand your horizons.

Interested in exploring the possibility of becoming a teacher?

Did you know that, on average, there is less than one qualified physics teacher per district in many school districts throughout the country? Would you like to be part of the solution to help train the next generation of scientists? SFSU has extensive resources to help students explore the teaching profession, including fellowships through the Center for Science & Mathematics Education (CSME, <https://csme.sfsu.edu>). For more information, make an appointment with Prof. Adrienne Cool (cool@sfsu.edu) who is our advisor for prospective K-12 science teachers.

Career Services & Leadership Development (CSLD) Office:

The mission of CSLD (<https://careerservices.sfsu.edu>) is to equip our diverse student and alumni population with modern resources that assist, guide, and foster their leadership, professional and career advancement.

Disability Access:

Students with disabilities who need reasonable accommodations are encouraged to contact all of their instructors early each semester. The Disability Programs and Resource Center (DPRC, <https://access.sfsu.edu>) is available to facilitate the reasonable accommodations process. The DPRC, located in Student Services Building 110, can be reached by phone at 415-338-2472 (voice/TTY) or by e-mail at dprc@sfsu.edu.

Religious Holidays:

The faculty of SFSU shall accommodate students wishing to observe religious holidays when such observances require students to be absent from class activities. It is the responsibility of the student to inform the instructor, in writing, about such holidays during the first two weeks of the class each semester. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed.

Student Disclosures of Sexual Violence:

SFSU fosters a campus free of sexual violence including sexual harassment, domestic violence, dating violence, stalking, and/or any form of sex or gender discrimination. If you disclose a personal experience as an SFSU student, faculty & staff are required to notify the Dean of Students. To disclose any such violence confidentially, contact:

- The SAFE Place - (415) 338-2208, http://www.sfsu.edu/~safe_plc/
- Counseling & Psychological Services Center - (415) 338-2208, <http://psyservs.sfsu.edu/>

For more information on your rights and available resources, see <http://titleix.sfsu.edu>.