Why study physics?

Students tend to take physics for one of two main reasons: they want to understand better how the universe works, or they have to because it is a requirement of their academic program. Of course, those two reasons are not mutually exclusive. If you are taking physics because it is required of you, it pays to consider why it is a requirement. Physics is included in academic programs because it teaches the fundamental laws of nature and how matter and energy interact. It also teaches problem-solving skills that are applicable to a wide range of disciplines. What is more, physics teaches an approach to problem solving that provides students with the tools they can use to solve new problems in new areas. In short, mastering first-year physics will make you a better student and improve the way you solve any problems that arise in your life.

At SFU we have four streams of first-year physics as shown below. You should complete the stream according to the requirements of your declared or intended program of study. Check the academic calendar or speak to the academic advisor for your program if you are not sure which one is right for you. If you are in a physics program (physics, applied physics, biological physics, chemical physics or mathematical physics) then you should be completing the enriched or the standard stream.

**Standard Stream:**
PHYS 120, PHYS 132, PHYS 121 and PHYS 133
For students in physical sciences and engineering programs.

**Enriched Stream:**
PHYS 125, PHYS 132, PHYS 126 and PHYS 133
For students with strong backgrounds in math and physics, recommended for students in physics majors and honours programs.

**Studio Stream:**
PHYS 140 and PHYS 141
Hands-on laboratory-based courses on the Surrey campus that include the laboratory component.

**Life-Sciences Stream:**
PHYS 101, PHYS 102 and PHYS 130
Physics taught with biological examples, designed for students in bioscience, kinesiology and health sciences. The Surrey offerings of PHYS 101 and 102 are taught in the studio format.
How do I study physics?

Most students find that learning physics is different from learning other subjects. In physics courses we focus on learning and applying concepts. The problem we often see is that students come to the subject with some misconceptions about how the world works, and it is not easy to change these misconceptions. Your course instructor may use clickers to test your thinking during lecture. Clicker questions are a great way to spot problems with the way you are thinking. It does not work to try to memorize physics. Your physics course will teach you problem-solving strategies and how to apply physical concepts. If you find yourself hunting through your textbook for the formula to use to solve a problem then chances are that you are not approaching the subject in the best way. At the university level, your instructor is not very likely to give you a problem that simply requires you to plug numbers into an equation. We have provided some specific guidelines for our lecture and laboratory courses below and also some guidelines for solving physics problems and writing physics exams.

The lecture courses:

**PHYS 101, 102, 120, 121, 125 and 126**

Traditional lectures have been used for centuries to teach many subjects including physics. Our modern understanding of the way people learn suggests that students learn better by doing rather than by hearing or seeing and so you’ll likely find that your lecture course has some active learning component to it (clickers, demonstrations, etc.). To get the most out of your lecture experience, we’d suggest the doing the following.

- Read the textbook before lecture.
  - Go slow, take notes, read for understanding, work the example problems
- Go to class regularly and actively participate.
- Take good notes
  - Write down an explanation of any figures or equations, when does the figure or equation apply, and when does it not apply
- Go over your notes after lecture to see if there are things that you do not understand.
- Seek help during office hours, open labs or tutoring sessions.
- Book time in your schedule to work on physics every day.
- Don’t fall behind
- Study with a friend, or make a friend with whom to study.
- Work through lots of example problems.
- Start problem sets early so that you can get help if you need it.
- Don’t search through the textbook for the right equation to use to solve a problem. Your instructor will have assigned problems that will test your understanding of the concepts, not problems that require a plug-and-chug approach.
The laboratory and studio courses:
PHYS 130, 132, 133, 140, 141 and also PHYS 101, 102 in Surrey

The laboratory environment provides a different kind of learning than the traditional lecture. For most students, seeing proof of the abstract concepts learned from the textbook or from lecture makes the subject much more real and relevant. Here are some tips for success in the studio and laboratory physics courses.

- Read the lab script before the lab session.
  - You don’t need to understand everything you will be doing in the lab beforehand – seeing the apparatus will make many of the instructions clear – but you should have a general idea.
- Use your time efficiently. Don’t get bogged by one part of the experiment.
  - Get help if the experiment doesn’t appear to be working properly.
- Learn the techniques and how to use the laboratory equipment to get reliable results.
- Learn the difference between accuracy and precision and how to determine how confident you can be in your experimental results.
- Learn to think about the errors that might be present in your experimental procedure.
  - Are the errors random or systematic? How will they affect the results?
- How will you analyze your data? Is there an accepted value for what you have measured?
  - What other data analysis could be done?
- Avoid confirmation bias.
  - It is not necessarily a bad thing when your experiment doesn’t give you the answer you expected. But when it doesn’t, you do want to try and understand why.

Solving physics problems

The first step to solving a physics problem is to determine what kind of problem you are solving. This is because there are similarities shared by common types of problems that permit us to use a common approach or process to solve problems of a particular type. Solving problems this way is characteristic of the expert approach to solving a problem. That is, the expert approach to solving a problem is different than that of a typical student. Here are some tips to help you approach physics problem solving like an expert.

- Make sure that you understand the problem.
  - Read the problem carefully and then read it again. Don’t lose marks by solving a different problem than the one that is asked.
- Draw a diagram and include only the relevant information.
- Consider what type of problem you are solving. If it is a kinematics problem, are you dealing with constant velocity motion or constant acceleration? Is the situation in the problem one with conservation of momentum (linear or angular?), conservation of energy or both?
- There is often more than one way to solve a problem. Take a moment to consider what other approaches might work and then choose which way you will solve the problem.
• If the final answer is a number, don’t include numbers in your equations until the final step.
  o Often values will cancel out and you’ll miss that if you are working with numbers.
• Often solving a physics problem requires building a mathematical model. This will often require you to determine what information is needed and what information is not needed (regardless of what information is provided).
  o Physicists love to talk about spherical cows: we can treat a cow as though it were a sphere, we just have to recognize that the model will not capture all of the details.
• Define your terms so that it is clear what you are doing.
• Provide statements that make your approach to solving the problem clear.
  o It is a lot easier to award part marks if you explain what you are doing and why.
• Work neatly so that the person grading can award you the marks you deserve.
  o Be careful that a reader can distinguish t from +, l from 1, and z from 2. If you need to write Greek letters, make sure that they are legible.
• In most cases it makes sense to work in SI units (metric).
  o In some situations units will cancel and so conversion is unnecessary.
• Does your solution take the symmetry of the problem into consideration? Do your vectors point in the right directions?
• Check whether your answer is reasonable. If it is not, check your math or your process.
• Be sure to include appropriate units for any value you report.
• Have you reported the correct number of significant figures?

Writing a physics exam.

Many of the tips from the problem solving section apply to writing a physics exam. But there are some tips that are unique to the examination that we’ll mention here.

• Stay on top of the work so you do not need to cram. Getting a good night’s sleep will improve your clarity of thought when you are writing the exam.
• Read all instructions carefully. You may be given a choice of questions to answer and in that case you don’t want to be doing work that won’t be graded.
• Make sure to write your name and student number on any examination paper or examination booklet. You want to get credit for the work you do and your instructor needs to know that it is your work.
• If your exam uses bubble sheets, be sure to fill in the circles completely using a soft pencil.
• Read through the exam and make notes in the margins.
• Apportion your time according to the marks for each question.
• Check over your work as time permits. Make sure you’ve provided an answer to each question.
• Review the exam after it is graded. Review this material before the final exam.
What do I do if I discover that I like studying physics?

We think that a degree in physics is a great way to prepare students for a career in an increasingly technological world. We offer several physics programs to take you in the direction of your future career. Contact our academic advisor (physhelp@sfu.ca) to discuss which of our physics programs is right for you.

Physics: Physics is the study of how the universe works and why it works that way. Physics students can choose either the major or honours program.

Applied Physics: Applied Physics combines fundamental physics with practical applications of physics concepts. Applied Physics students can choose either the major or honours program.

Biological Physics: Biological Physics uses quantitative skills to answer questions in the biological sciences on the molecular scale. Biological Physics students can choose either the major or honours program.

Chemical Physics: Chemical Physics provides an in-depth understanding of the fundamentals of both chemistry and physics, focusing on those areas that are at the interface of the two disciplines. Chemical Physics students can choose either the major or honours program.

Mathematical Physics: Mathematical Physics integrates the knowledge from physics and mathematics to explain how the universe works. Mathematical Physics is an honours program.