Concept-Based Study

Math courses and most science courses (including physics and chemistry courses) are different from, say, a history course or an English lit course. History and English are courses based on information, and math and science courses are based on problems.

In an information-based course:
- Classes are like lectures. The instructor introduces a topic and discusses it, sometimes one-sided and sometimes inviting feedback from students.
- Textbooks contain large amounts of text to read.
- Homework assignments tend to be reading assignments (in preparation for the next day’s class) or large writing assignments, such as research papers and essays.
- Your grade is based on how well you can write and convey information. Frankly, agreeing with what your instructor says can help your grade.
- The emphasis in the course is on memorization. You may be given vocabulary, dates, names, biographies, and so on, and your job is to synthesize it all so that you understand it. The more you can remember, the better you’ll do.
- Frequently, the bulk of the information you will need for a course is given to you during that course.

If you try to approach your math or science course with these ideas and strategies in mind, you won’t do well. Science and math courses benefit from a different approach.

In a problem-based course:
- Classes are like tutorials. The instructor may introduce a new concept and talk about it for a while, but a lot of the time the instructor is at the board writing definitions or theorems, or working through a problem.
- Textbooks contain some paragraphs to read, but there are boxes that have theorems in them, definitions in bold, diagrams, insets, and more examples of worked problems. Textbooks are not meant to be read from start to finish.
- Homework assignments are frequent and small, and consist of problems to solve, and the occasional short-answer question to ensure you understand the concepts you’re working with. Preparation for the class means doing problems from the textbook that are not part of the homework assignment.
- Grades are based on accuracy in solving problems. Your instructor’s judgment determines what part marks you get for an answer, but if you’re right, you’re right.
- The emphasis is partly on the core concepts of your course, which will need to be memorized, but mostly on your ability to solve problems, whether you’ve seen that type of problem before or not.
- Every concept you learn will build on things you’ve done in previous courses. You’ll be expected to know everything covered in the subject up to that point in your academic career.
Try these tips for science and math courses:

- **Take careful notes of any examples your instructor does in class. Write down any formulas and definitions that are covered and keep them in a list.** These are the building blocks you’ll use to get through the course. The examples in class can act as a template for problems assigned in the homework. They won’t be identical, but the concepts and method of solving should be similar.

- **When you are stuck on a problem from the textbook, look through that chapter for clues on how to solve the problem.** The problems are intended to be solved with the concepts introduced in the chapter – so it makes sense to go back if you’re stuck. If there are any math or science terms in the question that you don’t understand, look for their definitions in the chapter.

- **Do more problems than just the homework/assignments.** Your assignments prove to your instructor that you are keeping up with the class; but they aren’t enough practice for you to really learn the material. To stay sharp, do extra problems from the textbook, pick up a worksheet from the Learning Centre, use the web to find extra problem sets, or write your own problems.

- **Learn techniques; don’t memorize “facts”**. Most chapters of a math textbook introduce ~5–10 key ideas that you’ll need to know, such as definitions and formulas. Everything else you’ll learn in that chapter is about how to use those key ideas in problems, and identifying the appropriate concept (formula) for each situation. *It is not possible to memorize every possible question type you may encounter!* There are simply too many of them. You will need to practice your problem-solving skills to succeed.

- **Review what you’ve previously covered in that course (and even previous courses) occasionally.** Everything in these classes is cumulative. You are expected to remember all that you’ve done in previous courses. For example, the trigonometry you start in Math 11 becomes useful when dealing with vectors in Physics. You may need to review previous concepts in order to be able to work with new ones. (The handouts in the Learning Centre make great refreshers!)

- **Your calculator is only as smart as you are.** It can do arithmetic for you, but it can’t think for you. If you enter something incorrectly in your calculator, it doesn’t know and will produce an answer anyways. Always check the answers you get from your calculator to make sure they make sense.

- **Don’t wait to get help if you find the course hard from the start.** Math and science classes are cumulative. If you don’t understand atoms and molecules in the first weeks of chemistry, they’re not going away! The rest of the work you do in that course will be given out with the assumption that you’ve understood everything up to then. Make sure you thoroughly understand each concept you study before moving on. Get help from a tutor or other students as you need it.

So if memorization is not the way to go in math and science courses, what should you know and what should you study? A good way to learn new scientific information is to divide what you learn into concepts and arrange your notes on a concept into: what is it?, what does it mean?, what do I do with it?, and what else do I need to know about it? On the next page are a couple of examples.
If you keep all the information about a major concept in a science or math course in one place, you won’t have to go looking through all your notes to review for tests or to refresh your memory when you need the concept again later. Most importantly, don’t skip things you think are obvious now — they may not still be obvious when you need to review for next year’s class.