

**Fundamentals of Medicine and Dentistry  
Basic Scientific Principles that All Students Should Know Upon  
Entering Medical and Dental School at McGill**

Students entering medical and dental training come from a variety of educational backgrounds. The skills and knowledge that persons from varied backgrounds bring to the health professions offer many opportunities for positive contributions to their growth, overall excellence, and innovation in patient care and research.

Science and the scientific method, enacted through the compassionate lens of humanism, form the basis of medical knowledge and practice. Students admitted to our program *must thus have the required* prerequisite science courses in order to be considered for admission (available at: [www.mcgill.ca/medadmissions](http://www.mcgill.ca/medadmissions)).

Given the varied educational backgrounds of our admitted students, we provide below a list of scientific concepts which admitted students are expected to have been exposed to through the course of their prerequisite, general CEGEP and university level courses. These concepts have been identified by the MD CM curriculum leadership as foundational to the study of Medicine and Dentistry at McGill. This list is meant to assist admitted students in identifying areas they may wish to master prior to starting in the MD CM or DMD curricula. This list may also be useful to potential applicants in the course of planning their academic programs prior to applying to the MD CM or DMD programs at McGill.

**Basic Science Concepts you should be familiar with before starting medical or dental school:**

## ***Molecular Biology Core Concepts***

### ***The Central Dogma***

- What is DNA?
- Where is DNA found in the cell?
- What are the four nucleotide bases of DNA?
- What is base-pairing?
- What are the basics of DNA replication?
- What is a codon?
- What is a gene?
- How does DNA store genetic information?
- How is the genetic information in DNA transcribed into messenger RNA and then translated into proteins?
- What are the structural differences between DNA and RNA?
- Epigenetics- how does DNA methylation, histone acetylation and chromosome organization impact gene expression?
- Evolution- what is natural selection? What is descent with modification?

### ***Protein synthesis and function***

- What are amino acids?
- What is a protein?
- What functions do proteins carry out in cells?
- What is an enzyme?
- How do enzymes regulate biochemical reactions?

### ***Genetics***

- What are chromosomes?
- What are gametes?
- At the level of the chromosomes, what determines whether an organism will be male or female?
- What are the consequences of aneuploidy (not having a normal chromosome complement)?
- At a basic level, how are genetic traits inherited?
- What is a dominant gene/genetic disorder?
- What is a recessive gene/genetic disorder?
- What is a sex-linked genetic trait/disorder?

- What is multifactorial inheritance?
- What does it mean to clone a gene?

### ***Cell Biology Core Concepts***

- What is a cell?
- What are the differences between prokaryotic and eukaryotic cells?
- What is the cell membrane and what are its basic properties?
  - What are lipids? What is a lipid bilayer?
- What is the basic function of the following subcellular organelles?
  - nucleus
  - mitochondria
  - endoplasmic reticulum
  - Golgi apparatus
  - Ribosome

### ***Cell Division***

- What are the basic characteristics of cell division?
- What is the cell cycle?
- What is mitosis?
- What is meiosis?
- What is the difference between mitosis and meiosis?

### ***Cellular Signalling***

- How do cells communicate with each other?
- What is a hormone?
- What are ligands and receptors?
- How are receptors activated? What are the consequences of receptor activation?
- What is a 2nd messenger?
- What is a signalling pathway?

### ***Energy Metabolism***

- At a basic level, how does the body extract energy from nutrients?
- What is ATP?
- What is the difference between aerobic and anaerobic cellular respiration?
- What is glycolysis?
- What is the citric acid (Krebs) cycle?
- What is oxidative phosphorylation?

- What is the role of mitochondria in cell metabolism
- What is catabolism?
- What is anabolism?
- What are the roles of enzymes in catabolism and anabolism?

### ***Developmental Biology***

- What are the universal principles of animal development?
- What are the basic mechanisms underlying formation of the body plan?

### ***Chemistry***

- Basics of chemical reactions: equilibrium, rate constant, catalyst
- What is oxidation? Reduction?
- What is the Nernst equation?
- What is the chemical composition of carbohydrates? Proteins? Fatty acids? Nucleic acids?
- What is osmolarity, and how is it determined?
- What is an acid? Base? pH?
- Understand the chemical basis of metabolic reactions in living cells
- Have a basic understanding of atomic theory
- Have a basic understanding of the chemistry of alcohols, ethers, carbonyl compounds, and amines, aliphatic and aromatic compounds including modern concepts of bonding

### ***Physics***

- Have knowledge of core physical constants, physical quantities and vectors
- Have an understanding of Newtonian laws of motion and the concepts of work, energy, kinetic energy, potential energy, and power.
- Have an understanding of electrical charge, electrostatic force, electrical and magnetic fields, conductors, insulators, electric current, voltage, resistance, capacitance, Kirchhoff's Laws, resistors and capacitors in series and in parallel, time constant of a RC circuit, and use of an ammeter and voltmeter.
- Have an understanding of simple harmonic motion as applied to sound and light waves

### ***Statistics***

- What is a mean? Median? Mode?
- What is a normal distribution? Standard deviation?
- What are p-values and confidence intervals?
- What is probability?
- How are graphs read?

**McGill Faculty of Sciences Course Resources**  
**(Note these are not necessarily prerequisite courses):**

**1. CEGEP or CEGEP-equivalent courses**

**We expect that these CEGEP courses, or their equivalents, have been taken (with labs):**

**BIOLOGY**

General Biology 1 (101-NYA; OOUK)

General Biology 2 (101-NYB; OOXU)

**CHEMISTRY**

Chemistry 1 (202-NYA; OOUL)

Chemistry 2 (202-NYB; OOUU)

Organic Chemistry 1 (OOXV)

**MATHEMATICS**

Calculus I (201-NYA; OOUN)

**PHYSICS**

Mechanics (203-NYA; OOUR)

Electricity and Magnetism (203-NYB; OOUS)

Waves and Optics and Modern Physics (203-NYC; OOUT)

**See list at <http://www.mcgill.ca/students/transfercrredit/prospective/cegep> for CEGEP-by-CEGEP listing of which courses are acceptable.**

*All of the above courses are offered at McGill as 100-level CEGEP-equivalent courses (shown below):*

BIOL 111 Principles: Organismal Biology (3 credits)

<http://www.mcgill.ca/study/2013-2014/courses/biol-111>

BIOL 112 Cell and Molecular Biology (3 credits)

<http://www.mcgill.ca/study/2013-2014/courses/biol-112>

CHEM 110 General Chemistry 1 (4 credits)

<http://www.mcgill.ca/study/2013-2014/courses/chem-110>

CHEM 212 Introductory Organic Chemistry

<http://www.mcgill.ca/study/2013-2014/courses/chem-212>

CHEM 212 requires this course as a co-requisite:

CHEM 120 General Chemistry 2 (4 credits)

<http://www.mcgill.ca/study/2013-2014/courses/chem-120>

PHYS 101 Introductory Physics - Mechanics (4 credits)

<http://www.mcgill.ca/study/2013-2014/courses/phys-101>

PHYS 102 Introductory Physics - Electromagnetism (4 credits)

<http://www.mcgill.ca/study/2013-2014/courses/phys-102>

MATH 139 Calculus 1 with Precalculus (4 credits)

<http://www.mcgill.ca/study/2013-2014/courses/math-139>

## 2. University Level Courses

In addition to the above prerequisite courses, it is *required* that students know Biology, Physiology, Statistics, and Genetics at a level equivalent to the first-year introductory courses at McGill. Without these courses, it may be difficult to keep up with course material throughout the MDCM program.

***The Biology requirement consists of the two courses:***

BIOL 200 Molecular Biology (3 credits)

<http://www.mcgill.ca/study/2013-2014/courses/biol-200>

BIOL 201 Cell Biology and Metabolism (3 credits)

<http://www.mcgill.ca/study/2013-2014/courses/biol-201>

***The Physiology requirement consists of the two courses:***

PHGY 209 Mammalian Physiology 1 Physiology of body fluids, blood, body defense mechanisms, muscle, peripheral, central, and autonomic nervous systems. (3 credits)

<http://www.mcgill.ca/study/2011-2012/courses/phgy-209>

PHGY 210 Mammalian Physiology 2 Physiology of cardiovascular, respiratory, digestive, endocrine and renal systems. (3 credits)

<http://www.mcgill.ca/study/2012-2013/courses/phgy-210>

***The statistics requirement is satisfied by any of the following courses:***

**BIOL 373 Biometry (3 Credits)**

<http://www.mcgill.ca/study/2013-2014/courses/biol-373>

Biology (Sci): Elementary statistical methods in biology. Introduction to the analysis of biological data with emphasis on the assumptions behind statistical tests and models. Use of statistical techniques typically available on computer packages.

**PSYC 204 Intro to Psychological Stats (3 Credits)**

<http://www.mcgill.ca/study/2013-2014/courses/psyc-204>

Psychology: The statistical analysis of research data; frequency distributions; graphic representation; measures of central tendency and variability; elementary sampling theory and tests of significance.

**MATH 203 Principles of Statistics 1 (3 Credits)**

<http://www.mcgill.ca/study/2013-2014/courses/math-203>

Mathematics & Statistics (Sci): Examples of statistical data and the use of graphical means to summarize the data. Basic distributions arising in the natural and behavioural sciences. The logical meaning of a test

of significance and a confidence interval. Tests of significance and confidence intervals in the one and two sample setting (means, variances and proportions).

See list at <http://www.mcgill.ca/students/transfercrredit/prospective/cegep> for CEGEP-by-CEGEP listing of equivalent courses.

***The genetics requirement is satisfied by this course:***

BIOL 202 Basic Genetics (3 credits) <http://www.mcgill.ca/study/2013-2014/courses/biol-202>