Northern Ontario School of Medicine
École de médecine du Nord de l'Ontario

To: **Students of Entry Class 2019**

Re: **Suggested Pre-reading prior to arriving for the start of the MD Program**

Dear Student,

I would like to welcome you to the Northern Ontario School of Medicine Doctor of Medicine degree program. As the academic lead of your first two years of study (called Phase 1 in 'NOSM-speak') I am keen that everyone gets off to a good start.

The sciences are the key foundation on which medicine rests. You will be taught sciences relevant to medicine during Phase 1, with an initial four-week teaching module bringing all members of the class up to the same level of scientific knowledge.

We do expect students to possess basic scientific literacy however, particularly in the biological sciences. I am therefore sending to you a list of summertime readings intended to help you achieve this. You do not need to purchase these, they are available via the medical school library as described on the next sheet. You should use this list in a way which complements your current level of knowledge. In addition, I have included the science learning objectives for the initial four weeks along with the lectures' (Whole Group Sessions or WGSs) titles, focus, topics, resources and learning objectives to guide you in your reading and retention of the summertime readings.

Engaging with these materials is of particular importance to those of you who do not possess an undergraduate degree in the biological sciences and/or are already trained in another healthcare discipline. If you find you have difficulty understanding the concepts described in the reading list I also recommend that you consider working with a private tutor who can help you master the material.

With that said, please enjoy your summer and I will see you at Orientation Week.

Sincerely yours,

Brian M. Ross, PhD, MEd
Assistant Dean, Undergraduate Medical Education, Phase 1

cc: NOSM Education Services Librarian

Academic Year 2019-2020

Recommended pre-reading for students entering the UME Program

All of the following resources, with the exception of #4, can be accessed electronically through the NOSM library using your log-in credentials at this link. Item #4, Essential Cell Biology, is print only and available on reserve at the NOSM libraries located in the medical school buildings at Lakehead and Laurentian Universities.

1. Pollard, Thomas D., Earnshaw, William C., Lippincott-Shwartz, Jennifer and Johnson, Graham. (2017) *Cell Biology*. (3rd ed.) Philadelphia, PA: Elsevier.

   CHAPTERS
   Chapter 1: Introduction to cells
   Chapter 3: Molecules: structures and dynamics
   Chapter 13: Membrane structure and dynamics
   Chapter 28: Cells of the extracellular matrix and immune system
   Chapter 40: Introduction to cell cycle

2. Koeppen, Bruce M., Stanton, Bruce A. (2018) *Berne & Levy Physiology*. (7th ed.) Philadelphia, PA: Elsevier.

   CHAPTERS
   Chapter 1: Principles of cell and membrane function
   Chapter 2: Homeostasis: volume and composition of body fluid compartments
   Chapter 3: Signal transduction, membrane receptors, second messengers, and regulation of gene expression

3. Helbert, Matthew. (2017) *Immunology for Medical Students*. (3rd ed.) Philadelphia, PA: Elsevier.

   CHAPTERS
   Chapter 1: Introduction to the immune system
   Chapter 2: Basic concepts and components of the immune system

4. Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2014) *Essential Cell Biology*. (d 4th ed.) New York: Garland Science.

   CHAPTERS
   Chapter 1: Introduction to cells
   Chapter 2: Chemical components of cells

5. **Resources suggested by the Medical College Admissions Test (MCAT) as a guide of the student's knowledge of biological and biochemical concepts -** Biological and Biochemical Foundations of Living Systems, Chemical and Physical Foundations of Biological Systems

6. **Khan Academy – MCAT/Biology/Chemistry**

Module Learning Objectives (Sciences only)

Theme 4: Foundations of Medicine

Biochemistry

1. Outline the structure and function of the four classes of macromolecules in biological systems.
2. Outline how enzymes function to facilitate chemical reactions in cells.
3. Define metabolism, and outline how metabolic processes generate energy for cellular processes.

Cell Biology

4. Describe the organization of the cell, and the primary function of each of the sub-cellular organelles.
5. Outline the processes by which cells communicate with one another.

Genetics

6. Define “transcription” and “translation”, and outline how these processes direct the production of proteins based on DNA sequences.
7. Describe the normal complement of chromosomes in human cells, and describe their structural features.
8. Outline the processes by which cells replicate themselves and their genetic material.
9. List the major types of DNA mutations and chromosomal abnormalities and describe the effects.
10. Describe the basic patterns of Mendelian inheritance, and explain in general terms how genes determine phenotype.

Physiology

11. Describe the relationship between the different types of body fluids, and explain why solute concentrations are important in maintaining proper fluid balance.
12. Outline the processes by which molecules are transported in and out of cells.
13. In general terms, describe the importance of electrochemical gradients in biological systems, and explain how these gradients are built and maintained.
14. Explain why homeostasis is important for the survival of organisms, and outline the mechanisms that operate to maintain homeostasis.

Anatomy, Histology & Embryology

16. Use proper anatomical terminology to describe and understand body position and movement.
17. Identify the levels of organization of the human body, and describe the major organ systems.
18. Identify the components of a light microscope, and demonstrate its proper use and maintenance.
19. Outline how cells associate to form tissues, and describe the major tissue types in humans.
20. Identify the major body regions and list the major organs found in each.
21. Outline the progression of embryonic and foetal development in humans.

Pathology

23. Outline the inflammatory process, and identify the local and systemic effects of inflammation.

24. Outline the processes by which cells die, and describe the outcomes of these processes.
25. Outline the processes by which cells and tissues adapt to external circumstances and respond to injury to restore integrity and function.
26. Outline the processes that regulate blood clotting, and describe the major disturbances involving hemodynamics and maintenance of blood flow.
27. Describe the different types of neoplasms.

Microbiology

29. Describe the major types of microorganisms that affect humans, and recognize that symbiotic relationships with microbes can be beneficial, neutral, or harmful to the host.
30. Describe techniques used to differentiate between types of bacteria and other microorganisms.
31. Describe the generalized structure of bacteria, recognizing that bacteria are an extremely diverse group of organisms.
32. Describe the generalized structure of viruses, and outline the life cycle of a typical animal virus.
33. Describe methods used to control the growth of microbes.

Immunology

34. Recognize the common origin of all blood cells, and outline the functions of the erythrocytes, platelets, and the leukocyte subtypes involved in immunity.
35. Outline the contribution of the innate and adaptive immune responses in the generation of immunity.
36. Outline the course of a 'typical' adaptive immune response, including antigen presentation, T cell activation, B cell activation, and antibody production.
37. Outline the roles of complement, antibodies, and phagocytes in immunity.

Pharmacology

38. Define key terms in pharmacology relating to pharmacodynamics, pharmacokinetics, and toxicology.
39. Recognize that drugs work by binding to and altering the function of cells or infectious agents, and that they are inactivated by being degraded or excreted from the body.
40. Describe drug nomenclature and classification.
41. Explain the mechanisms of drug action.
42. Explain the absorption, distribution, metabolism, and elimination of drugs.

Autopsy Examination

43. Explain the purpose of the autopsy examination, and describe how an autopsy is performed.

Introduction to Diagnostic Imaging

44. Describe how images are produced by the various modalities used for medical diagnoses.
45. Recognize the benefits and risks of the various modalities used in medical imaging.
46. Compare and contrast the benefits and limitations of different radiologic modalities including: plain film, CT, MRI, ultrasound, nuclear medicine.
47. Recognize the temporal relationships of medical imaging.
48. Describe how different tissues/objects produce various grey scale images in radiography (radiographic densities).
49. List the five radiographic densities (air, fat, soft tissue/fluid, bone, and metal/contrast) as seen on radiographs.

Whole Group Sessions

WGS - The Internal Life of the Cell

Student Guide

Focus
The cell is the basic structural and functional unit of all living organisms. In this session we will consider the major components of a cell, including the macromolecules that are their building blocks and the sub-cellular organelles that carry out specific functions. Finally, we will examine some of the major functions carried out by a cell, including the synthesis of proteins based on information carried in DNA sequences, the role of enzymes in cell functions, and the conversion of nutrients to usable forms of energy.

Topics
Macromolecules
Cellular organization
Transcription & translation
Enzymes
Metabolism

Resoures Theme 4

Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Walter, P. (2014). *Essential cell biology* 4th ed.). New York: Garland Science.

Baker, R.R., & Murray, R.K. (2001). *PDQ biochemistry*. Hamilton, ON: B.C. Decker.

Baynes, J.W., & Dominiczak, M.H. (2014). *Medical biochemistry* (4th ed.). Edinburgh: Saunders/Elsevier. Retrieved from the NOSM website in the Health Sciences Library (HSL) e-Books section.

Kratz, R.F., & Siegfried, D.R. (2010). *Biology for dummies* (2nd ed.). Hoboken, NJ: Wiley.

Theme 4 Learning Objectives

Students should be able to:

Biochemistry

- Name the four classes of macromolecules in biological systems and outline their structure and function in general terms.
- Outline the chemical composition and structure of carbohydrates and distinguish between monosaccharides, disaccharides, and polysaccharides.
- List the primary biological functions of carbohydrates.
- Outline the chemical composition, structure, and function of nucleic acids and nucleotides in general terms.
- Outline the role of nucleotides as carriers of energy, especially in the form of ATP.
- Distinguish between deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) with respect to the number of strands, the nucleotides they are comprised of, the type of sugar found in their backbone, and their biological functions.
- Outline how the complementarity of nucleotides facilitates the transmission of genetic information during DNA replication and the synthesis of RNA.

- Outline the chemical composition and structure of amino acids and proteins and describe how the chemical properties of each amino acid determine the overall structure and function of the protein.
- Briefly describe the major biological functions of proteins, including structural proteins, enzymes, transporters, immunoglobulins, hormones, and regulatory proteins.
- Outline the chemical composition and structure of lipids, including fatty acids, triglycerides, cholesterol and phospholipids.
- Briefly describe how lipids serve as hormones, for energy storage, in signalling, and in the formation of cell membranes.

Cellular Organization

- Describe the major structures found in eukaryotic cells, including the cell membrane, nucleus, mitochondria, endoplasmic reticulum, golgi apparatus, cytoskeleton, peroxisomes, and lysosomes, and list the functions of each.
- List the components of the cell membrane and briefly describe their functions, including the phospholipid bilayer, cholesterol, and membrane proteins.

Cellular Functions

- Define “transcription”, and outline how messenger RNA (mRNA) is synthesized.
- Define “translation”, and explain how the sequence of nucleotides in RNA specifies the sequence of amino acids to be assembled into a protein.
- Outline how enzymes function to catalyze chemical reactions in living cells.
- Describe how enzyme activity can be affected by temperature, pH, the presence of inhibitors, and the availability of energy in the form of ATP.
- Describe how the maximum speed at which enzymes can function is controlled, and that many biochemical and pharmacological systems can be saturated.
- Define “metabolism” and distinguish between anabolism and catabolism.
- Outline the processes of cellular respiration, including glycolysis, the citric acid cycle, and oxidative phosphorylation.

WGS - The External Life of the Cell

Student Guide

Focus

We have previously considered the cell as an isolated entity. However, all cells must interact with their environment and with other cells as well. In this session, we will investigate how cells interact with other cells to form multicellular structures and communicate, and how they relate to their environment in order to maintain their structural and functional integrity.

Topics

Cellular associations
Membrane proteins and membrane potential
Transport
Cell signaling and intercellular communication
Homeostasis

Resources

Theme 4

Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Walter, P. (2014). *Essential cell biology* 4th ed.). New York: Garland Science Pub.

Baker, R.R., & Murray, R.K. (2001). *PDQ biochemistry*. Hamilton, ON: B.C. Decker.

Baynes, J.W., & Dominiczak, M.H. (2014). *Medical biochemistry* (4th ed.). Edinburgh: Saunders/Elsevier. Retrieved from the NOSM website in the Health Sciences Library (HSL) e-Books section.

Hall, J.E. (2016). *Guyton and Hall textbook of medical physiology* (13th ed.). Philadelphia, PA: Elsevier-Saunders. Retrieved from the NOSM website in the Health Sciences Library (HSL) e-Books section.

Seidel, C.L. (2002). *Basic concepts in physiology: A student's survival guide*. New York: McGraw-Hill.

Kratz, R.F., & Siegfried, D.R. (2010). *Biology for dummies* (2nd ed.). Hoboken, NJ: Wiley.

Theme 4 Learning Objectives

Students should be able to:

Homeostasis

- Define "homeostasis", and explain why the maintenance of homeostasis is important for the survival of cells and multicellular organisms.
- Describe the role of negative feedback in maintaining homeostasis.
- Describe the role of positive feedback in maintaining

homeostasis. Intercellular contact and communication

- Distinguish between occluding junctions, anchoring junctions, and communicating junctions, and recognize the importance of these cellular associations in the formation of tissues.
- Outline how interactions between receptors and their ligands can initiate processes that allow cells to respond to their environment.
- Distinguish between contact-dependent, autocrine, paracrine, and endocrine as modes of intercellular communication.
- Describe how a single receptor can activate multiple substrates in the form of a cascade, resulting in amplification of the strength of the original signal.

Movement of molecules across the cell membrane

- Define "solvent" and "solute", and distinguish between isotonic, hypertonic, and hypotonic solutions.
- Contrast the composition of the extracellular and intracellular fluids with respect to their relative content of ions.
- Define "osmotic equilibrium".
- Distinguish between "diffusion", "osmosis", "facilitated diffusion", and "active transport".

- Outline the differential permeability that cell membranes have to sodium, potassium, calcium, and chlorine ions.
- Recognize that the permeability of transmembrane protein channels to ions can be controlled by differences in charge across the membrane, or by the binding of chemicals.
- Describe how the concentration gradient of ions across the membrane and the permeability of the membrane to each ion determines membrane potential, and how the cell can alter its membrane potential.
- Describe the role of a membrane potential in generating an action potential.
- Describe how the sodium/potassium pump operates to maintain the sodium and potassium concentration differences across the cell membrane.

WGS - Introduction to Genetics

Student Guide

Focus

The fundamentals of gene structure and expression will be introduced along with the mechanisms of mitosis and meiosis in the transfer of DNA to somatic and germ cells. Basic concepts of inheritance, chromosome structure and complement, and the effects of genetic mutations and chromosomal defects will be described.

Topics

- Gene structure and expression
- Chromosome structure and complement
- Karyotypes
- Cell cycle and mitosis
- Meiosis and genetic recombination
- Chromosome translocations
- Basic patterns of inheritance

Resources

Theme 4

Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Walter, P. (2014). *Essential cell biology* 4th ed.). New York: Garland Science Pub.

Strachan, T. & Read, A. (2011). *Human Molecular Genetics* (4th ed.). New York: Garland Science.

Tortora, G. J., & Derrickson, B. (2014). *Principles of Anatomy and Physiology* (14th ed.). Hoboken, N.J.: Wiley.

Theme 4 Learning Objectives

Students should be able to:

Foundations of Genetics

- Define “gene”, and differentiate between coding and non-coding DNA sequences.
- Outline how mutation in DNA can produce a mutant protein.
- Define “reading frame”, and explain how mutations that disrupt the reading frame of a gene (i.e., insertions and deletions) can severely impair the function of the resultant protein.
- Outline other common types of mutations found in DNA, including substitutions, inversions, and silent mutations.
- Define “genome”, and explain in general terms that every cell in a multicellular organism has a copy of the entire genome, and recognize that genes can be turned on and off to control their expression only at appropriate times and in appropriate places.

Cytogentics

- Outline the chemical composition of chromosomes and identify their basic structural features including chromatids, centromere, long arm and short arm.
- Define “karyotype”, and outline how size, centromere position, arm lengths, and banding patterns can be used to identify them.
- Differentiate between autosomes and sex chromosomes, and describe identify the normal complement of chromosomes in humans.
- Define “haploid”, “diploid”, “euploid”, and “aneuploid”.

Mitosis and Meiosis

- List the phases of the normal cell cycle, and explain terminal differentiation in terms of permanent exit from the cell cycle.
- Define “mitosis” and outline how it leads to equal division of genetic material into daughter cells.
- Define “meiosis” and outline its function in gametogenesis.
- Outline how errors in meiosis can lead to aneuploidies and other chromosomal aberrations

Mendelian Inheritance

- Distinguish between genotype and phenotype.
- Define “allele”, and distinguish between dominant and recessive alleles.
- Describe the three basic patterns of Mendelian inheritance (autosomal dominant, autosomal recessive, and sex-linked) and identify the most likely pattern of inheritance given a family history.

WGS – Introduction to Embryology

Student Guide

Focus

This session will examine the events that take place during human ontogeny, from the fertilized egg to the fetus. The development of major adult tissue types from embryological precursors will be described.

Topics

- Development of the zygote and implantation
- Establishment of the trophoblast
- Gastrulation and the origins of the ectoderm, mesoderm and endoderm
- Neurulation and the development of somites
- Establishment of the cardiovascular system
- Development of the placenta
- Folding of the trilaminar embryo
- Origins of head and neck structures and limbs
- Teratogens

Resources

Moore, K. L., Persaud, T. V. N. & Torchia, Mark G. (2016). *Before We are Born: essentials of embryology and birth defects* (9th ed.) Philadelphia, PA: Saunders-Elsevier,

Tortora, G. J., & Derrickson, B. (2014). *Principles of Anatomy and Physiology* (14th ed.). Hoboken, N.J.: Wiley.

Learning Objectives

Theme 4: Foundations of Medicine

- Distinguish between embryo and fetus stages during development.
- Outline the major stages of embryonic development, including the morula, blastula, gastrula, and neurula phases.
- Describe the formation of the zygote upon fertilization and the development of the zygote into a morula followed by development into a blastula.
- Outline the structures of the blastula – epiblast and hypoblast.
- Outline the process of implantation, the development of the trophoblast and recognize the significance of the trophoplast in terms of production of human chorionic gonadotropin (hCG).
- Outline the structure of the gastrula, including the development of the endoderm, mesoderm and ectoderm from the epiblast.
- Outline the development of the amnion and the yolk sac in the structure of the gastrula.
- Identify the main tissues and organs that arise from the ectoderm, endoderm, and mesoderm.
- Outline the process of neurulation, including the development of the primitive streak, primitive node and the notochord from the primitive node.
- Distinguish between the formation of the neural tube and the neural crest structures and recognize their relationship to the central and peripheral nervous systems.
- Recognize the development of somites from mesoderm in conjunction with the closure of the neural tube.
- Recognize that somites differentiate into sclerotome, myotome and dermatome and identify the main tissues that derive from each structure.
- Outline the development of lateral and splanchnic plate mesoderm, the formation of the intraembryonic coelom, the establishment of the cardiogenic region near the cranial end of the embryo and the formation of the primitive heart from the cardiogenic region.
- Outline the development of blood cells and vasculature from the intraembryonic coelom in the lateral plate mesoderm.
- Outline the folding of the embryo to form the primitive gut from the endoderm.
- Describe the development of the embryonic placenta from the chorionic membrane and the vasculature.
- Outline how the pharyngeal arches and clefts and the optic lens and otic placodes contribute to

the structures of the face.
- Recognize that the final structures of the brain, the skeleton, the limbs, digits, and eyes form in the last three weeks of the embryonic period.
- Recognize that no new structures form after the end of the embryonic period, but that existing structures develop further.
- Explain why the 3rd and 4th week of embryonic development is a particularly crucial period of development, and sensitive to the influence of teratogens.
- Outline the principal changes that occur during the fetal period in humans.

WGS - Principles of Pharmacology

Student Guide

Focus

This session provides an introduction to basic pharmacology. Particular emphasis will be on the description of the basic principles of pharmacodynamics and pharmacokinetics.

Topics

- Definition of key terms in pharmacology
- Drug absorption, distribution, metabolism, and elimination
- Pharmacodynamics
- Pharmacokinetics

Resources

Theme 4

Chapter 1: Principles of pharmacology and mechanisms of drug action
Chapter 2: Pharmacokinetics
Waller, D.G., Sampson, A.P., Renwick, A.G., & Hillier, K. (2014). *Medical pharmacology and therapeutics* (4th ed.). New York: Elsevier-Saunders. Retrieved from the NOSM website in the Health Sciences Library (HSL) e-Books section.

Theme 4 Learning Objectives

Students should be able to:

Definitions of key pharmacological terms
- Define the following terms:
  - Pharmacology,
  - Pharmacy,
  - Toxicology,
  - Drug,
  - Poison,
  - Pharmacodynamics,
  - Pharmacokinetics.
  - Describe drug nomenclature and classification.

- Define the following drug properties:
- Agonist,
- Antagonist,
- Partial agonist,
- Affinity,
- Efficacy,
- Intrinsic activity,
- Potency.

Pharmacodynamics

- Describe a typical dose-response curve for a drug, and identify the positions on the curve that are used to define drug potency and efficacy.
- Identify molecular targets for drug action
- Define therapeutic effect, side effect, adverse effect and toxic effect of drugs
- Define 'receptor' and list the four major types of receptors
- Define ED50, LD50, TD50, and therapeutic index.
- Distinguish between selectivity of effect and specificity of drug action.
- Distinguish between drug tolerance, and tachyphylaxis.

Pharmacokinetics

- Define absorption, distribution, and elimination (metabolism and excretion).
- Describe the various routes by which drugs can enter the body and list the advantages and disadvantages associated with each route of administration.
- Outline the molecular mechanisms of drug absorption.
- Outline how chemical and physiological factors effect drug absorption.
- Differentiate between "actual volume of distribution", and "apparent volume of distribution".
- Describe the different sites of drug distribution and list the factors that affect the distribution of a drug throughout the body.
- Explain the anatomical (epithelial, endothelial) and functional (membrane transport systems) barriers to drug movement.
- Describe the role of the blood-brain barrier and its relationship to drug distribution.
- Outline the major enzyme systems within the body that activate and inactivate drugs.
- List the major isozymes of cytochrome P-450 (CYP) with respect to drug metabolism in humans.
- Outline the major routes of excretion of drugs from the body.
- Explain the terms "zero" and "first" order kinetics and explain what they mean in terms of a drug's mode of action.
- List examples of commonly prescribed drugs that follow first-order and zero-order kinetics.
- Define loading dose, maintenance dose, volume of distribution, clearance, and elimination half-life.
- Describe the one-compartment and two-compartment model of drug distribution and elimination.

WGS - Infection and Immunity

Student Guide

Focus

This session will consider the types of microorganisms that are known to cause disease in humans, and the mechanisms by which we defend ourselves from them. The key characteristics of the different types of these organisms will be discussed, and methods for their identification will be briefly introduced. We will also give an overview of common techniques used to control and kill microbes. The major players in the immune response will be introduced, with an overview of the course of a typical immune response to infection.

Topics

Categories of microorganisms
Generic structures of bacteria and viruses
Sterilization and disinfection
Major functions of white blood cells.
Innate and adaptive immunity.
The course of a 'typical' adaptive immune response.

Resources

Ingraham, J.L. & Ingraham, C.A. (2004). *Introduction to microbiology: A case history approach* (3rd ed.). Pacific Grove, CA: Brookes/Cole.

Parham, P. (2015). *The immune system* (4th ed.). New York: Garland Science.

Theme 4 Learning Objectives

Students should be able to:

Characterizing microorganisms

- List the types of organisms that cause disease in humans.
- Define "normal flora".
- Write microbial names using appropriate scientific format.
- Explain why different culturing and staining techniques are used to identify microorganisms.
- Explain how gram staining is useful in the characterization of bacteria.
- Define "acid fast" with respect to bacteria, and explain how this classification is useful in characterization of bacteria.
- Outline how different types of bacteria can have very different requirements for hydrogen, carbon, nitrogen, sulfur, phosphorus, and oxygen.

Structure and replication of microorganisms

- Describe the structure of a generic bacterium, including the cell wall, capsule, nucleoid, flagellum, pilus, and fimbriae.
- Describe the structure and important chemical components of the bacterial cell wall.

- Use correct scientific terminology to describe cell shape, size, and colony morphology of different types of bacteria.
- Describe the structure of a generic virus, including the genetic material, capsid, and envelope.
- Describe the steps in the replication of a generic animal virus, and recognize that viruses can only replicate inside a host cell.
- Briefly describe the morphology and reproduction of fungi.

Sterilization disinfection

- Describe how temperature, pH, electromagnetic radiation, solute concentrations, and desiccation can affect growth and survival of microbes.
- Distinguish between sterilization, disinfection, and sanitization.

White Blood Cells

- Outline the functions of leukocytes, erythrocytes, and platelets.
- Recognize that all blood cells arise from common progenitors in the bone marrow.
- Outline the major functions of T lymphocytes, B lymphocytes, eosinophils, neutrophils, and monocytes.

Innate and Adaptive Immunity

- Define “immunity” and distinguish between innate and adaptive immune responses.
- Outline the course of a typical adaptive immune response, including antigen presentation, T cell activation, B cell activation, and antibody production.
- Outline the roles of helper and cytotoxic T lymphocytes in the adaptive immune response.
- Outline the roles of B lymphocytes in the adaptive immune response.
- Describe the generalized structure of an antibody, and outline the major functions of antibodies in immune responses.
- Distinguish between ‘primary’ and ‘secondary’ immune responses.
- List the beneficial and potentially detrimental effects of immune responses.

WGS - Disease Processes

Student Guide

Focus

This session will examine major topics in histology and pathology. Major tissue types and their functions will be outlined. You will consider introductory concepts and principles related to the main pathological processes that underlie many clinical disorders.

This session will provide general understanding of histology and pathology that you will apply in later modules.

Topics

- Tissue types and their functions
- Inflammation
- Cell injury
- Cell degeneration and adaptation

- Repair and regeneration
- Thrombosis, embolism, & infarction
- Neoplasia, metaplasia, and hyperplasia

Resources

Theme 4

Kumar, V., Abbas, A.K., & Aster, J.C. (Eds.). (2015). *Robbins and Cotran pathologic basis of disease* (9th ed.). Philadelphia, PA: Elsevier/Saunders. Retrieved from the NOSM website in the Health Sciences Library (HSL) e-Books section.

Young, B., O'Dowd, G., & Woodford, P. (2014). *Wheater's functional histology: A text and colour atlas* (6th ed.). New York: Churchill Livingstone. Retrieved from the NOSM website in the Health Sciences Library (HSL) e-Books section.

Theme 4 Learning Objectives

Students should be able to:

Inflammation

- List and explain the cardinal signs of inflammation.
- Distinguish between acute, chronic, and granulomatous inflammation, and contrast their etiology, cellular composition, and time course.
- Describe the haemodynamic and permeability changes associated with acute inflammation, and list the chemical mediators responsible for it.
- Discuss the potential outcomes of acute inflammation.
- Outline the systemic effects resulting from local inflammation, including fever, leukocytosis, and the acute phase reaction.
- Distinguish between edema and congestion

Cell Degeneration and Adaptation

- Distinguish between apoptosis and necrosis with respect to causes, processes, morphological features, and outcomes.
- Outline the pathological effects of amyloid.
- Distinguish between metastatic and dystrophic calcification.
- Distinguish between hypertrophy, hyperplasia, hypoplasia, metaplasia, involution, and atrophy.
- Distinguish between labile, stable, and permanent cells.
- Distinguish between regeneration and repair.
- Outline the process of wound healing, noting the role of growth factors, and the factors that can impair healing.
- Describe the adverse effects of wound healing.
- Distinguish between primary and secondary union in wound healing.

Thrombosis, embolism, and infarction

- Distinguish between thrombosis, embolism, and infarction.
- Outline the process of haemostasis, including the roles of the vascular endothelium, coagulation factors,

and platelets.

- Define fibrinolysis, and recognize that fibrinolysis and haemostasis are normally in balance.

Neoplasia

- Distinguish between benign and malignant neoplasms with respect to growth rate and potential for invasion and metastasis.
- Distinguish between the terms neoplasia, tumour, and cancer.

Date	Authors/Comments/Amendments/Approvals
2018 03 20	Presented to P1C for 1st reading
2018 04 17	Approved by P1C
2018 02 19	Approved by P1C