CCNM
CANADIAN COLLEGE OF NATUROPATHIC MEDICINE

# COURSE OUTLINE FALL 2024

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| **Course:** | Physiology |
| **Course Code:** | SPH100 |
| **Times & Location:** | Online Tutorial: Thursdays 8 – 9 p.m. EST/ 5-6 p.m. PT |
| **Course Coordinator:** | Dr. Philippe D'Onofrio Ph.D., M.Sc. |
| **Instructors/Teaching Assistants:** | Dr. Philippe D'Onofrio Ph.D., M.Sc. |
| **E-mail:** | pdonofrio@ccnm.edu |
| **ZOOM Link:** | https://ccnm-edu.zoom.us/j/4301051742 |
| **Office Hours:** | By appointment |
| **Office Location:** | Online |

**Evaluation:**

| | PERCENT | TEST DATE / DUE DATE |
|---|---|---|
| **Participation** | 10% | On-Going |
| **Module Quizzes** | 10% | 16 Weekly Quizzes |
| **Assignments** | 10% | Weekly Completion |
| **Midterm Test** | 30% | **October 17, 2024** |
| **Final Exam** | 40% | **December 5, 2024** |

**Plagiarism** and cheating are academic offenses and will be treated seriously by the College. Students should refer to the College's policies on academic misconduct posted on in the **Academic Calendar**. Students may seek guidance from several style manuals located in the CCNM library.

**Required Texts:**
Dee Unglaub Silverthorne Human Physiology: An Integrated Approach (8th Edition). Published by Pearson.

**Course Description:**
Physiology (SPH100) is a three-credit, 14-week introductory course that will provide students with a solid core foundation in basic and applied physiology. The course will emphasize clinical physiology including mechanisms by which cells and tissues of the body operate to maintain homeostasis, and the integrative functions of the major systems of the human body in health and disease.

The application of physiology fundamentals to naturopathic medicine is integrated throughout the course, providing students with a unique opportunity to learn physiology within the context of naturopathic medicine.

**Course Outcomes:**

**On completion of the course the student will be expect to:**
- Demonstrate knowledge of organ systems function
- Demonstrate knowledge of cellular function
- Demonstrate the ability to integrate physiology from the cellular and molecular level to the organ system
- Effectively read and communicate scientific information
- Apply understanding of physiological processes in the clinical setting

**Pedagogy:**

The course is delivered in a blended learning style which combines online self-study modules with weekly live interactive online tutorial sessions from 8:00 - 9 p.m. EST (one evening per week) with the course instructor.

**Evaluation:**

The passing grade is 60%, and evaluations/assessments will consist of one quiz per module (10%), participation (10%), several assignments (10%), one midterm test (30%) taken online, and a final exam (40%) invigilated virtually through Examity. It is the student's responsibility to register for the midterm test and final exam.

**SPH100 – Physiology**

**Lecture Schedule**

| Wk | Date | Topic | Modules |
|---|---|---|---|
| 1 | September 5, 2024 | Introduction | Introduction to the course |
| 2 | September 12, 2024 | Module 1 and 2 | Cells and Tissues, Communication, and Integration |
| 3 | September 19, 2024 | Module 3 | Endocrine System |
| 4 | September 26, 2024 | Module 4 and 5 | Neurons and CNS |
| 5 | October 3, 2024 | Module 6 | Sensory Physiology |
| 6 | October 10, 2024 | Module 7 and 8 | Autonomic and Motor Control, Muscle Physiology |
| 7 | **October 17, 2024** | **Midterm** | **Midterm (no tutorial)** |
| 8 | October 24, 2024 | Module 9 and 10 | Cardiovascular System and Blood Flow and Pressure |
| 9 | October 31 2024 | Module 11 | Blood Physiology |
| 10 | November 7, 2024 | Module 12 and 13 | Mechanics of Breathing and Gas Exchange |
| 11 | November 14, 2024 | Module 14 | Kidney Physiology |
| 12 | November 21, 2024 | Module 15 | Gastrointestinal Physiology |
| 13 | November 28, 2024 | Module 16 | Reproductive Physiology |
| 14 | **December 5, 2024** | **Final Exam** | **Final Exam (no tutorial)** |

***The Academic Department reserves the right to make schedule changes.***

**SPH100 - Physiology**
**Session Learning Outcomes**

**Week 1**
*Deadline: Post a brief introduction on "Please introduce yourself" forum before the start of the tutorial.*

**Introduction to SPH100 Physiology Course**
By the end of this session, the student will be able to:

- Navigate Moodle SPH100 course shell and Collaborative Assignment programs
- Discuss plagiarism
- Understand course requirement, including textbook readings, evaluations and deadlines
- Begin completion of Modules 1

**Week 2**
*Deadline: Complete Modules 1 and 2 before the start of the tutorial.*

**Module 1 and 2: Cells and Tissues, and Communication, Integration and Homeostasis**
By the end of this session, the student will be able to:

- Name and describe the major body cavities and compartments.
- Explain the four major functions of the cell membrane.
- Draw and label the fluid mosaic model of the cell membrane and describe the functions of each component.
- Compare a phospholipid bilayer to a micelle and a liposome.
- Map the organization of a typical animal cell.
- Draw, name, and list the functions of organelles found in animal cells.
- Compare the structures and functions of the three families of cytoplasmic protein fibers.
- Compare and contrast cilia and flagella.
- Describe five major functions of the cytoskeleton.
- Name the three motor proteins and explain their functions.
- Describe the organization and function of the nucleus.
- Explain how protein synthesis uses compartmentation to separate different steps of the process.
- Describe the structure and functions of extracellular matrix.
- Describe the role of proteins in the three major categories of cell junctions.
- Compare the structures and functions of the four tissue types.
- Describe the anatomy and functions of the five functional categories of epithelia.
- Compare the anatomy and functions of the seven main categories of connective tissue.
- Use structural and functional differences to distinguish between the three types of muscle tissue.
- Describe the structural and functional differences between the two types of neural tissue.
- Explain the differences between apoptosis and necrosis.
- Distinguish between pluripotent, multipotent, and totipotent stem cells.
- List as many organs as you can for each of the 10 physiological organ systems.

- Describe three forms of local communication and two forms of long-distance communication.
- Explain the general sequence of events that follow lipophilic ligand binding to intracellular receptors.
- Describe the general sequence of events that follow lipophobic ligand binding to a cell surface receptor.
- Name and describe four major groups of cell surface receptors.
- Explain how cascades and signal amplification play a role in signal transduction.
- List five ways calcium acts as an intracellular messenger.
- Describe the advantages and disadvantages of gaseous second messenger molecules.
- Apply the concepts of specificity, competition, affinity, and saturation to receptors and their ligands.
- Explain the role of up-regulation, down-regulation, and pathway termination in modulating cell responses to receptors and their ligands.
- List Cannon's four postulates of homeostatic control and give an example of each.
- List the seven steps of a reflex control pathway in the order in which they occur.
- Compare the speed, specificity, types of signals, and duration of action in neural and endocrine reflexes. How is stimulus intensity coded in each type of reflex?
- Describe some examples of complex reflex pathways with more than one integrating center.

**Week 3**
*Deadline: Complete Modules 3 before the start of the tutorial.*

**Module 3: Introduction to the Endocrine System**
By the end of this session, the student will be able to:

- Explain the four criteria that make a chemical signal a hormone.
- Explain what the cellular mechanism of action of a hormone is.
- List three chemical classes of hormones and give an example of each.
- Compare endocrine cells' synthesis, storage, and release of peptide and steroid hormones.
- Compare the location of hormone receptors and the cellular mechanisms of action of peptide and steroid hormones.
- Compare the three main groups of amine hormones.
- Describe the role of the nervous system in endocrine reflexes.
- Compare the structure and function of the anterior and posterior pituitaries.
- List the six anterior pituitary hormones, the hormones that control their release, and their primary targets.
- Compare long-loop negative feedback for anterior pituitary hormones to the negative feedback loops for insulin and parathyroid hormone.
- Explain permissiveness, synergism, and functional antagonism as they apply to hormones.
- Name the three most common types of endocrine pathologies.
- Explain how negative feedback can be used to determine the location of a problem with one gland in a two- or three-gland pathway.
- Explain how comparative endocrinology is useful for understanding human physiology.

**Week 4**

**Modules 4 and 5: Neurons: Cellular and Network Properties & The Central Nervous System**

By the end of this session, the student will be able to:

- Map the organization of the nervous system in detail.
- Draw and describe the parts of a neuron and give their functions.
- Describe the parts of a synapse and their functions.
- Name the types and functions of glial cells.
- Explain in words how the Goldman-Hodgkin-Katz equation relates to the membrane potential of a cell.
- Explain the relationships between the following terms: current flow, conductance, resistance, Ohm's law.
- Compare and contrast graded potentials and action potentials.
- Explain the changes in ion permeability and ion flow that take place during an action potential.
- Describe and compare absolute and relative refractory periods.
- Explain the role of myelin in the conduction of action potentials.
- Distinguish between electrical and chemical synapses.
- List and give examples of the seven groups of neurocrine secretions.
- Describe different patterns for neurotransmitter synthesis, recycling, release, and termination of action.
- Describe the role of the following in synaptic communication: ionotropic and metabotropic receptors, neurotransmitters and neuromodulators, fast and slow synaptic potentials, excitatory and inhibitory postsynaptic potentials.
- Compare temporal and spatial summation.
- Compare presynaptic and postsynaptic inhibition.
- Explain the mechanism of long-term potentiation mediated by AMPA and NMDA receptors.
- Explain and give examples of emergent properties of neural systems in humans and other organisms.
- Describe how nervous systems increase in complexity from Cnidarians to mammals.
- Describe how a hollow neural tube develops into the ventricles and seven major divisions of the CNS.
- Define grey matter, white matter, tracts, and nuclei in the CNS.
- Starting at the skull and moving inward, name the membranes and other structures that enclose the brain.
- Explain the formation, distribution, and functions of cerebrospinal fluid.
- Describe the structure and functions of the blood-brain barrier.
- Explain how the following structures are organized in the spinal cord: ascending and descending tracts, columns, dorsal root ganglia, dorsal and ventral horns, dorsal and ventral roots, propriospinal tracts, spinal nerves
- Name the major subdivisions of the cerebrum, cerebellum, diencephalon, and brain stem, and give their major functions.
- Name the four lobes of the cerebral cortex and explain which sensory, motor, or association areas are associated with each lobe.
- Explain the behavioral state system and how it is related to the diffuse modulatory systems and the reticular activating system.
- Describe the stages of sleep.
- Describe motivation and emotion and how they are related to brain function.

- Explain the role of the following in learning and memory: short-term memory, memory traces, working memory, associative and non-associative learning, and habituation and sensitization.
- Explain the roles of Wernicke's area and Broca's area in written and spoken language.

**Week 5**
**Module 6: Sensory Physiology**
By the end of this session, the student will be able to:

- Describe the different types of receptors for somatic and special senses.
- Explain how receptors convert physical stimuli into electrical signals using the following terms: transduction, threshold, adequate stimulus, receptive field, receptor potential.
- Explain how the central nervous system is able to determine modality, location, intensity, and duration of a stimulus.
- Explain how tonic and phasic receptors adapt to a continuous stimulus.
- Trace the pathways for somatic sensation from receptor to the somatosensory cortex.
- Describe the different types of somatosensory receptors.
- Explain how pain and itch are mediated by nociceptors and describe the neural pathways for pain.
- Describe the receptors, sensory transduction, and neural pathways for olfaction.
- Describe the receptors, sensory transduction, and neural pathways for the five primary taste sensations.
- Trace the anatomical pathway sound energy follows from the air until it becomes an action potential in a primary sensory neuron.
- Describe the anatomical pathway for sound transmission from the cochlea to the auditory cortex.
- Explain how hair cells convert sound energy into an action potential.
- Explain how otoliths and the cupula convey information about movement and head position to the vestibular nerve.
- Describe the structures of the eye and the role of each structure in vision.
- Trace the pathway for vision from the retina to the visual cortex.
- Explain how photoreceptors convert light energy into action potentials.
- Explain signal processing in the retina and in the visual cortex.

**Week 6**
**Modules 7 and 8: Efferent Division: Autonomic and Somatic Motor Control and Muscle Physiology**
By the end of this session, the student will be able to:

- Describe the physiological role of the autonomic division and its branches.
- Compare and contrast the anatomy and chemical communication of the sympathetic and parasympathetic branches.
- Describe the synthesis and breakdown of autonomic neurotransmitters.

- Describe the structure and secretions of the adrenal medulla.
- Describe the structure of the neuromuscular junction.
- Compare the anatomy, neurotransmitters and receptors of the somatic motor, sympathetic, and parasympathetic divisions.
- Draw and label a series of diagrams to show the different levels of organization of skeletal muscle.
- Diagram the sliding filament theory of contraction.
- Diagram the molecular events of excitation-contraction coupling and the contractile cycle.
- Discuss the different possible causes for muscle fatigue.
- Discuss the differences between slow-twitch fibers, fast-twitch oxidative-glycolytic fibers, and fast-twitch glycolytic fibers.
- Explain how muscle length influences force of contraction.
- Distinguish between summation and the different types of tetanus.
- Define a motor unit and explain how skeletal muscles use them to create graded contractions.
- Compare and contrast isometric and isotonic contractions.
- Describe and give examples of how bones and muscles form fulcrums and levers.
- Diagram smooth muscle anatomy.
- Diagram smooth muscle contraction and relaxation.
- Explain slow wave potentials, pacemaker potentials, and pharmacomechanical coupling.
- Compare and contrast cardiac muscle with skeletal and smooth muscle.

**Week 7**
**Date: June 20, 2024 - Midterm**

**Week 8.**
**Modules 9 and 10: Cardiovascular Physiology and Blood Flow and Control of Blood Pressure**
By the end of this session, the student will be able to:

- Describe the functions of the cardiovascular system and give examples of each function. Describe the organization of the cardiovascular system, starting and ending in the aorta.
- Define and explain the relationships among pressure, hydrostatic pressure, pressure gradients, flow, velocity of flow, resistance, and radius as they relate to the cardiovascular system.
- Describe in detail the internal and external anatomy of the heart.
- Describe the two types of myocardial cells and their arrangement in the heart.
- Describe the membrane proteins and ion movement involved in myocardial excitation-contraction coupling and relaxation.
- Compare and contrast actions potentials of myocardial autorhythmic and contractile cells.
- Describe the conduction of electrical signals through the heart.
- Describe the parts of an electrocardiogram and explain how these electrical events are related to the mechanical events of the cardiac cycle.
- Explain the pressure changes that occur during the cardiac cycle and their relationship to flow through the heart and blood vessels.
- Explain the relationship of heart rate, cardiac output, and stroke volume.
- Explain the role of the autonomic divisions in control of heart rate at the cellular and molecular level.

- Explain how the following factors influence stroke volume: venous return, length-tension relationships, preload, afterload, contractility, skeletal muscle pump, respiratory pump, inotropic agents.
- Compare and contrast the structure, mechanical properties, and functions of the five major types of blood vessels.
- Explain what creates blood pressure and how blood pressure changes as blood flows through the systemic circulation.
- Explain the relationship between blood flow, pressure gradients, and the resistance of the system to flow. Use Poiseuille's Law to explain the factors that influence resistance.
- Describe how blood pressure is estimated using sphygmomanometry.
- Explain the contributions of cardiac output and peripheral resistance to blood pressure. Calculate mean arterial pressure.
- Explain how changes in blood volume affect blood pressure.
- Define myogenic autoregulation and explain its role in altering local blood flow.
- List and describe the major paracrine molecules involved in local control of blood flow. Describe the hormonal and neural control of blood vessel diameter, including significant neurotransmitters and their receptor types.
- Explain how the body can use local and long-distance signaling to direct blood flow to or away from specific organs or tissues.
- Describe in detail the steps of the baroreceptor reflex, including the stimulus, sensor, input pathway, integrating center(s), output pathways, target(s), cellular response(s), tissue response(s), and systemic response(s). Include all chemical signal molecules and their receptors as well as any feedback loops.
- Describe the different types of capillaries and where they are found in the body.
- Explain why the velocity of blood flow is lowest in the capillaries.
- Explain the role of diffusion and transcytosis in capillary exchange.
- Explain the forces that influence capillary filtration and absorption.
- Describe the anatomy and functions of the lymphatic system and how the lymphatics are related to the circulatory and immune systems.
- Explain the pathological factors that might alter capillary exchange and result in edema.
- List the controllable and uncontrollable risk factors for cardiovascular disease.
- Describe the progression of events that result in atherosclerosis.
- Explain why hypertension represents a failure of homeostasis

**Week 9**
**Module 11: Blood**
By the end of this session, the student will be able to:

- Describe the composition of plasma and list the major functions of plasma proteins.
- List the cellular elements of blood, including immature forms and subtypes, and describe the function(s) and distinguishing characteristics of each.
- Describe the differentiation of blood's cellular elements, starting from a pluripotent hematopoietic stem cell and including key cytokines involved in development.
- List the components of a complete blood count.
- Compare the structures of immature and mature red blood cells.
- Describe the molecular structure of hemoglobin.
- Create a map of iron metabolism and hemoglobin synthesis.
- Describe the common pathologies of red blood cells.
- Describe the production, structure, and functions of platelets.

- Distinguish between hemostasis and coagulation.
- Diagram the key steps of hemostasis, coagulation, and fibrinolysis.

**Week 10**
**Modules 12 and 13: Mechanics of Breathing and Gas Exchange and Transport**

By the end of this session, the student will be able to:

- List four major functions of the respiratory system.
- Diagram the anatomy of the respiratory system and explain the function of each structure.
- Explain and express mathematically the relationship between atmospheric pressure, water vapor pressure, and the partial pressures of individual gases.
- Explain the relationship between the pressure of a gas and the volume in which it is contained.
- Define and describe the lung volumes and lung capacities.
- Explain how pressures and lung volumes change during normal breathing, and how that affects air flow in the respiratory system.
- Explain how subatmospheric intrapleural pressure develops and the role it plays in normal breathing.
- Graph the alveolar and intrapleural pressure changes that occur during one respiratory cycle.
- Compare and contrast compliance and elastance in respiratory physiology, giving examples of disease states that demonstrate changes in compliance and/or elastance.
- Explain the role of surface tension and surfactants in respiratory physiology.
- Map the factors affecting airway resistance, with emphasis on local and reflex control mechanisms involved in bronchodilation and bronchoconstriction.
- Compare and contrast total pulmonary ventilation and alveolar ventilation.
- Explain why gas composition in the alveoli remains relatively constant during normal breathing and how it changes with hyper- and hypoventilation.
- Explain the local control mechanisms by which ventilation and alveolar blood flow are matched.
- Compare obstructive and restrictive lung diseases.
- List three arterial blood parameters that influence ventilation.
- Diagram the normal partial pressures of $O_2$ and $CO_2$ in the atmosphere, alveoli, arterial blood, resting cells, and venous blood.
- Describe all the factors that influence gas exchange between the atmosphere and arterial blood.
- Explain the difference between the concentration of a gas in solution and the partial pressure of that gas in solution, using $O_2$ and $CO_2$ as examples.
- Explain how the Fick equation uses mass flow and mass balance to relate cardiac output and cellular oxygen consumption.
- Explain the role of hemoglobin in oxygen transport from the molecular level to the systemic level.
- Describe the relationship between plasma $O_2$ P and oxygen transport. Draw the oxyhemoglobin saturation curve, explain the physiological significance of the shape of this curve, and draw the shifts in the curve that result from changes in pH, temperature, and 2,3-BPG.
- Compare and contrast oxygen transport on fetal and adult hemoglobin.

- Write the chemical reaction for the conversion of $CO_2$ to $HCO_3^-$, including the enzyme that catalyzes the reaction.
- Map the transport of carbon dioxide in arterial and venous blood, including the exchanges of $CO_2$ between the blood and the alveoli or cells.
- Map the reflex control of ventilation including appropriate neurotransmitters and their receptors.
- Diagram the current model for the brainstem neural networks that control breathing.
- Explain the mechanisms by which central and peripheral chemoreceptors monitor $CO_2$ and $O_2$ levels.
- Describe the protective reflexes that guard the lungs.

**Week 11**
**The Kidneys**
By the end of this session, the student will be able to:

- List and describe the six functions of the kidneys.
- Trace the anatomical path of a drop of water from Bowman's capsule to urine leaving the body.
- Trace the anatomical path of a drop of blood from the renal artery to the renal vein.
- Diagram the anatomical relationship between the vascular and tubular elements of the nephron.
- Describe the three processes of the nephron.
- Diagram the volume and osmolarity changes of filtrate as it passes through each section of the nephron.
- Describe the filtration barriers between the blood and the lumen of the nephron, and explain how they can be modified to control filtration. Describe the pressures that promote and oppose glomerular filtration.
- Define glomerular filtration rate and give average values for GFR.
- Explain how GFR can be influenced by local and reflex control mechanisms.
- Distinguish between transcellular transport and paracellular pathways.
- Describe and give examples of active and passive reabsorption in the proximal tubule.
- Using glucose as an example, create graphs to show filtration, transport maximum, and renal threshold of a substance reabsorbed by protein-mediated transport.
- Explain and give examples of the importance of tubular secretion in renal function.
- Explain mathematically and in words the relationship between the excretion of a solute and its renal clearance.
- Explain how clearance can be used as an indirect indicator of renal handling of a solute.
- Diagram the involuntary micturition reflex

**Week 12**
**The Digestive System & Metabolism and Energy**
By the end of this session, the student will be able to:

- Trace a piece of undigested food from mouth to anus.
- Describe the four layers of the GI tract wall.
- Describe the primary function of the digestive system.

- Explain the challenges of autodigestion, mass balance, and defense. Describe and compare secretion, digestion, absorption, and motility.
- Describe single-unit smooth muscle, slow wave potentials, tonic and phasic contractions.
- Describe and compare peristalsis, segmentation, and the migrating motor complex.
- Compare the enteric nervous system to the central nervous system.
- Contrast long reflexes, short reflexes, and control involving GI peptides.
- Name the three families of GI hormones and give examples of each.
- Explain feedforward control in digestion.
- Map the processes and control pathways of the cephalic phase.
- Explain the functions of saliva and the process by which it is secreted.
- List the steps of the deglutition (swallowing) reflex.
- Explain the three functions of the stomach.
- Map the processes and control pathways of the gastric phase.
- Describe the gastric secretions and their major actions.
- Compare and contrast digestion and motility in the large and small intestine.
- Describe the anatomy and function of the hepatic portal system.
- Describe the major secretions of the pancreas and liver.
- Diagram the cellular mechanisms for secretion or absorption of water and ions.
- Diagram the digestion and absorption of carbohydrates, proteins, and fats.
- Explain the neural and hormonal control of the intestinal phase of digestion.
- Explain the role of bacteria in the gut.
- Describe the GALT.
- Contrast the protective reflexes of vomiting and diarrhea.
- Diagram the control pathways that influence hunger and satiety.
- Explain how we measure energy use and metabolic rate in humans.
- Identify the factors that affect metabolic rate.
- Distinguish between anabolic and catabolic pathways, and name as many specific pathways as possible.
- Distinguish between the fed (absorptive) state and the fasted (postabsorptive) state. Describe the possible fates of ingested nutrients and indicate which is the most common for each class of biomolecules.
- Create a map that summarizes the balance of nutrient pools and nutrient storage for carbohydrates, proteins, and lipids.
- Explain the regulatory significance of push-pull control.
- Create a summary diagram for anabolic metabolism of carbohydrates, proteins, and lipids in the fed state.
- Explain the relationship between different forms of cholesterol and cardiovascular disease.
- Create a summary diagram for catabolic metabolism of carbohydrates, proteins, and lipids in the fasted state.
- Explain the roles of insulin and glucagon in the control of metabolism
- Create a reflex map for insulin, including mechanisms of action where possible.
- Draw a reflex map for glucagon, including mechanisms of action where possible.
- Compare type 1 and type 2 diabetes mellitus. Explain how treatments for diabetes are related to the pathophysiology of the disease.
- Create a map for type 1 diabetes to show the body’s responses to elevated plasma glucose in absence of insulin.
- Explain the normal routes of heat gain and loss for the human body.
- Map the homeostatic control of body temperature.

**Week 13**
**Reproduction and Development & Review**
By the end of this session, the student will be able to:

- Describe the role of sex chromosomes in sex determination.
- Describe the bipotential reproductive structures of the early embryo.
- Diagram the processes of sexual differentiation in male and female embryonic development.
- Describe and compare male and female patterns of gametogenesis.
- Diagram the common hormonal control and feedback pathways for reproductive function.
- Explain the significance of pulsatile GnRH secretion.
- Describe some environmental factors that influence reproductive physiology.
- Diagram the internal and external anatomy of the adult male reproductive and accessory structures and give the function(s) of each.
- Diagram the process and timeline of spermatogenesis.
- Explain the hormonal control of spermatogenesis.
- Describe the primary and secondary sex characteristics of the male and the hormones that influence their development.
- Diagram the internal and external anatomy of the adult female reproductive and accessory structures and give the function(s) of each.
- Diagram and give the timeline for follicular development from primordial follicle to corpus albicans.
- Explain the role of atresia in ovarian function.
- Diagram the ovarian and uterine stages of the menstrual cycle.
- Relate the hormonal control and feedback patterns of the menstrual cycle to different stages of the ovarian and uterine cycles.
- Describe the secondary sex characteristics of the female and the hormones that influence their development.
- Diagram the erection reflex and describe the four phases of the human sexual response.
- Explain the anatomy or physiology of currently available contraceptive methods.
- Describe the common causes of male and female infertility.
- Diagram the process of sperm capacitation and fertilization of an ovum.
- Diagram the process of embryo development from fertilization through implantation in the endometrium.
- Describe the role of placental hormones during pregnancy.
- Describe what we currently understand about the processes of labor and parturition.
- Diagram a mammary gland and the control of milk and colostrum production.
- Diagram the let-down (milk ejection) reflex.
- Describe how the reproductive systems of males and females change at puberty and with menopause and andropause.

**Week 14**
**Final Exam**