**Physiology Thread Map**

## Overview

* Physiological concepts are presented throughout the pre-clerkship curriculum often in conjunction with other threads. Students are instructed on the structure (**anatomy** and **histology**) and function (**physiology**) of human tissue in health and disease (**pathology**).
* Physiology concepts in the pre-clerkship curriculum are organized by tissue and organ systems. The fundamentals of transport, connective tissue proper, an introduction of blood, epithelial tissue, and the lymphatic system are covered in OST 520 - Foundations of Biomedical Science for Osteopathic Medicine in semester 2a.
* In semester 2b, the connective tissues cartilage and bone are discussed, along with nervous and muscle tissues in OST 521 - Musculoskeletal System with the remainder of blood covered in OST 522 - Hematology, Oncology, and Infectious Diseases.
* The remaining organ systems are covered as follows: semester 3a OST 523 - Neurological System; semester 3b OST 525 - Genitourinary System and OST 526 - Endocrine System; semester 4 OST 531 - Reproductive, Development, and Sexuality, OST 532 - Integumentary System, and OST 533 - Gastrointestinal System; semester 6 OST 534 - Cardiovascular System and OST 535 - Respiratory System.

## Framework

* **Physiology**: The science that describes the function of cells and the organizational and functional relationships between cells, tissues, organs, and body systems

## Semester 1

**OST 510 – Clinical Human Gross Anatomy**

* None

**OST 550 – Introduction to Osteopathic Medicine and Clinical Skills**

* None

## Semester 2a

**OST 520 – Foundation of Biomedical Science for Osteopathic Medicine**

* Transport - *Schwartz*
  + Elements of signaling
  + Cell to cell signaling
* Connective tissue - *Xiao*
  + Extracellular matrix
  + Glycosaminoglycans, proteoglycans, and adhesive glycoproteins
  + Structural features of collagen polypeptide
  + Elastic fibers and reticular fibers
  + Connective tissue cells
  + Connective tissue organization
* Blood cells and hemopoiesis - *Schwartz*
  + Blood composition
  + Blood cell production (hematopoiesis)
  + Laboratory parameters evaluated in a complete blood count and differential
* Epithelial tissue - *Kennedy*
  + General considerations
  + Cell morphology and cell arrangement
  + Cell-to-cell and cell-to-extracellular matrix junction
  + Cell surface specializations
  + Secretory specializations - characteristics of glands
* Epithelial transport - *Schwartz*
  + Basic Transport Mechanisms
  + Active Transport
  + Examples of Transepithelial Transport
* Lymphatic system - *Schwartz*
  + Lymphoid Tissues
  + Thymus
  + Lymph Nodes
  + Spleen
  + Peyer’s Patch
  + Appendix

**OST 551 – Osteopathic Patient Care**

* None

**OMM 511 – Osteopathic Manipulative Medicine**

* None

## Semester 2b

**OST 521 – Musculoskeletal System**

* Cartilage and Bone 1 - *Schwartz*
  + Cartilage development
  + Types of cartilage
  + Synovial joints
  + Cartilage pathology
  + Cartilage damage and repair
* Cartilage and Bone 2 - *Schwartz*
  + Types of bone
  + Ossification
  + Bone cells and matrix
  + Bone remodeling
  + Bone growth
  + Injury and repair
  + Bone pathology
* Nerve 1 - *Crandall*
  + Overview of nerve tissue
  + Membranes potentials
* Nerve 2 - *Crandall*
  + Action potentials
  + Neurotransmitters and synaptic function
* Skeletal Muscle 1 - *Slade*
  + Overview of skeletal muscle
  + Ultrastructure of muscle fiber
  + Innervation
  + Adaptation
* Skeletal Muscle 2 - *Slade*
  + Sliding filament mechanism of contraction
  + Excitation contraction coupling
  + Energy
  + Functional properties of skeletal muscle
* Cardiac Muscle - *DiCarlo*
  + Cardiac action potential
  + Excitation-contraction coupling
  + Cardiac contractility
* Smooth Muscle - *DiCarlo*
  + Smooth muscle physiology
  + Excitation-contraction coupling
  + Vascular Smooth Muscle

**OST 522 – Hematology, Oncology, and Infectious Diseases**

* Complete Blood Count and differential - *Schwartz*
  + White blood cell count (WBC)
  + Red blood cell count (RBC)
  + Hematocrit (HCT)
  + Hemoglobin (Hb)
  + Mean corpuscular volume (MCV)
  + Mean corpuscular hemoglobin (MCH)
  + MCH concentration (MCHC)
  + Platelet count
  + Neutrophils (+ bands)
  + Lymphocytes
  + Eosinophils
  + Monocytes
  + Basophils
* White Blood Cell Physiology, Morphology - *Schwartz*
  + Myeloid-Lymphoid Cell Differentiation
  + Functional WBC Morphology
  + Non-Neoplastic WBC Disorder

## Semester 3a

**OST 523 – Neurological System**

* Principles of Neurobiology I - *Atkin*
  + Nervous system organization and naming
  + Planes of section and directional terminology
* Principles of Neurobiology II - *Atkin*
  + Pain
  + Revealing some principles of neurobiology
* Cells, Synapses & Neurotransmitter Systems - *Nazaroff*
  + Cells of the nervous system
  + Neurochemical communication in the brain
  + Neurotransmitter projection systems
* Meninges, Ventricular system, Cerebrospinal Fluid, Blood Brain Barrier, and CNS Blood Supply - *Ward*
  + Meninges
  + Cerebrospinal fluid and ventricles
  + Blood Brain Barrier
  + Blood supply of the brain and spinal cord
* Spinal Cord I: Anatomy, Internal Organization, and Spinal Nerves - *Tilden*
  + General structures of the spinal cord
  + Internal features of the spinal cord
  + Meninges of the spinal cord
  + Blood supply to the spinal cord
  + Spinal nerve and its function
  + Dermatomes, myotomes, and peripheral nerves
* Spinal Cord II: Ascending Tracts - *Tilden*
  + Dorsal column-medial lemniscus pathway
  + Lateral spinothalamic tract
* Spinal Cord III: Motor Function and Spinal Reflexes - *Tilden*
  + Corticospinal tract
  + Spinal reflexes
  + Spinal shock
* Autonomic Nervous System - *Tilden*
  + Control of the autonomic nervous system
  + Neurogenic orthostatic hypotension
  + Horner’s syndrome
  + Autonomic dysreflexia
* Autonomic Reflexes: Micturition - *Tilden*
  + Overview of autonomic nervous system structures entering the pelvis
  + Innervation of the urinary bladder
  + Micturition cycle
  + Lesions and outcomes
* Visual System – Central Visual Pathway - *Tilden*
  + Structure of the retina
  + Visual fields vs. retinal fields
  + Optic nerve and optic chiasm
  + Optic radiations and the primary visual cortex
* Brainstem I – Introduction and Anatomy – *Kerver/Weber*
  + Overview of the brainstem
  + Major long fiber pathways that traverse the brainstem
  + Upper vs lower motor neuron syndrome
  + Cranial nerves
  + Simplified overview of the cerebrospinal fluid pathway through the brainstem
* Brainstem Patterns – *Kerver/Weber*
  + Cranial nerve nuclei
  + Organization of cranial nerve nuclei within the brainstem
  + Crossed signs
  + Introduction to the Rules of 4
  + Review of brainstem vasculature
* Internal Anatomy of the Medulla - *Kerver/Weber*
  + Medulla overview
  + Cranial nerves of the medulla
  + Internal anatomy of the medulla
  + Blood supply to the medulla
  + Medulla stroke syndromes
* Internal Anatomy of the Pons - *Kerver/Weber*
  + Pons overview
  + Cranial nerves of the pons
  + Internal anatomy of the pons
  + Blood supply to the pons
  + Pontine stroke syndromes and lesions
* Internal Anatomy of the Midbrain - *Kerver/Weber*
  + Midbrain overview
  + Overview of the spatial distribution of cranial nerves III, IV, and VI
  + Cranial nerves of the midbrain – III and IV
  + Blood supply and midbrain syndromes
  + Corticobulbar innervation of brainstem motor nuclei
* Brainstem – Eye Movements and Visual Reflexes - *Kerver/Weber*
  + Overview of eye movements and visual reflexes
  + Pupillary light reflex
  + Pupil-related defects
* Auditory and Vestibular Systems - *Kerver/Weber*
  + Overview of the vestibulocochlear system
  + Audition/hearing
  + The vestibular system
* Principles of Motor Control - *Atkin*
  + Principles of motor control
  + The hardware you use to move
  + When things go wrong
* The Basal Ganglia - *Atkin*
  + Anatomy and neurotransmitters of the basal ganglia
  + Inputs and outputs of the basal ganglia
  + Circuitry of the basal ganglia, dopamine, and disordered movements
  + Psychological manifestations of the basal ganglia
  + Blood supply of the basal ganglia
* The Cerebellum - *Atkin*
  + Overview
  + Anatomy of the cerebellum
  + Functional subdivisions of the cerebellum
  + Information and the cerebellum: Where does it come from, where does it go?
  + But how does it work?!
  + Blood supply
  + Clinical features
* Cerebral cortex, white matter & somatosensory systems - *Atkin*
  + Introduction
  + Layers upon layers
  + Functions of cortex and cortical specialization
  + Clinical significance of regional specialization
  + Cortical compensation
* Thalamus - *Atkin*
  + Introduction
  + Understanding the thalamus through stroke
  + Consequences beyond stroke
* Hypothalamus and Pituitary - *Atkin*
  + Introduction
  + Nuclei of the hypothalamus
  + The Hypothalamus-pituitary-adrenal gland axis
  + Pituitary tumors
* Olfaction & Taste – *Lovell*
  + Olfaction: stimuli and receptors
  + Olfaction: transduction
  + Olfaction: primary sensory neurons and central pathway
  + Olfaction: effects of lesions
  + Gustation: stimuli and receptors
  + Gustation: transduction
  + Gustation: primary sensory neurons and central pathway
  + Gustation: effects of lesions
* Higher Cortical Functions I - *Burghardt*
  + Introduction
  + Memory
  + Neglect
* Higher Cortical Functions II - *Burghardt*
  + Language
  + Praxis
* Normal sleep and sleep disorders - *Ward*
  + Introduction to normal sleep patterns
  + Stages of sleep
  + Development patterns and changes with aging
  + Functions of sleep
  + Neural mechanisms involved in the sleep-wake cycle
  + Genetic aspects
  + General concepts of sleep disorders
  + Hypersomnias
  + Insomnias
  + Parasomnias
  + Comorbidity with psychiatric disorder
* Seizures - *Ward*
  + Seizures
  + Definitions
  + Primary generalized epilepsy syndromes
  + Localization-related epilepsy syndromes
  + History and PE
  + Diagnostic work up
  + Treatment
* Motor Neuron and Electrodiagnostics (EDX) - *Flink*
  + Motor Control
  + Upper Motor Neurons
  + Lower Motor Neurons
  + Muscle Influences
  + Alpha (α) Motor Neuron
  + Neuromuscular Junction
  + Neuromuscular Transmission
  + Excitation-Coupling Contraction
  + Motor Unit
  + Motor Unit Size
  + Muscle Fiber Type
  + Types of Muscle Contraction
  + Muscle Relaxation
  + Neural Control of Muscle Contraction
  + Muscle Fatigue
  + Motor Units Recruitment Order
  + EDX Nomenclature
  + EDX Key points
  + Role of EDX
  + Nerve Conduction terminology
  + Setup-Nerve Conduction Studies
  + Nerve Conduction Studies
  + Measurement of Conduction Velocities
  + Nerve Conduction Study-CMAP, SNAP, Repetitive stimulation
  + Repetitive stimulation-Neuromuscular junction disorders
  + Electromyography (EMG)
  + Electromyography-Motor Unit Action Potential (MUAP)
  + Motor Unit Action Potential Recruitment, Activation and Firing Patterns
  + Electromyography-Neuropathic abnormalities
  + Myopathic
* Neurobiology of Pain & Abnormal Pain State - *Ward*
  + Introduction
  + Definitions of terminology
  + Nociception at the periphery and processing in spinal cord dorsal horn
  + Pain pathways to cortex
  + Pain perception
  + Pain pathways for head pain and trigeminocervical complex
  + Chronic pain - general comments and proposed mechanisms
  + Types of pain categorized in patients
* Ophthalmology Afferent & Efferent - *D. Kaufman*
  + Optic nerve function
  + Chiasm lesions
  + Retrochiasmatic lesions
  + Oculomotility

**OST 524 – Psychopathology**

* None

**OST 552 – Osteopathic Patient Care**

* None

**OMM 512 – Osteopathic Manipulative Medicine**

* None

## Semester 3b

**OST 525 – Genitourinary System**

* Functional Anatomy - *DiCarlo*
  + Structure and function of the kidney
* Hemodynamics of Glomerular Filtration - *DiCarlo*
  + Renal blood flow and its distribution
  + Renal hemodynamics
  + Regulation of glomerular filtration rate and renal blood flow
* The Clearance Principle - *DiCarlo*
  + Measurement of glomerular filtration rate
  + Measurement of renal clearance
  + Filtration fraction
  + Measurement of renal plasma flow; renal clearance of p-aminohippuric acid
* The Proximal Tubule - *DiCarlo*
  + Early proximal tubule
  + Proteins
  + Peritubular capillary uptake
* Loop of Henle, Distal Tubule, and Collecting Duct - *DiCarlo*
  + Solute and water transport in the loop, distal tubule, and collecting duct
  + Water reabsorption along the nephron
  + Solute and water reabsorption along the nephron in the presence and absence of Antidiuretic hormone
  + Requirements for forming concentrated urine
* Renal Regulation of Plasma Osmolality - *DiCarlo*
  + The control of water excretion
  + Physiology of antidiuretic hormone
  + Disorders
* Regulation of Plasma Volume and the Renal Control of Blood Pressure - *DiCarlo*
  + Connection between sodium, water, and blood pressure
  + Extracellular volume sensing systems
* Hyponatremia - *L.* *Kaufman*
  + Definition of hyponatremia
  + Plasma sodium concentration and regulation of plasma and extracellular fluid osmolality
  + Changes in tonicity affect cell volume
  + Neurologic signs & symptoms caused by hypotonic hyponatremia
  + Antidiuretic hormone
  + Renal dilution and concentration of urine
  + Determining the cause of hyponatremia
  + Laboratory evaluation of patients with hyponatremia
  + Treatment of hyponatremia
  + Osmotic demyelination syndrome
* Regulation of Potassium and Calcium Balance - *DiCarlo*
  + Acute regulation of internal potassium distribution
  + Basic renal mechanisms for potassium
  + Mechanism for potassium secretion in the cortical collecting duct
  + Potassium secretion and fluid delivery in the cortical collecting duct
  + Interaction of opposing factors on potassium secretion
  + Homeostatic control of potassium secretion by the cortical collecting duct
* Tubular Transport of Acids and Bases - *DiCarlo*
  + General renal handling of acids and bases
  + The kidneys respond to an acid load
* Basic Principles of Acid-Base 1 & 2 - *DiCarlo*
  + Hydrogen cation
  + Henderson-Hasselbalch equation
  + Sources of non-volatile acid
  + Acid-base disorders
  + The anion gap

**OST 526 – Endocrine System**

* Introduction to the Endocrine System - *L.* *Kaufman*
  + Hormone-producing organs/tissues chart
  + Endocrine, paracrine, and autocrine signaling
  + Hormone receptors
  + Hormone structure
  + Hormone secretion rhythms and patterns
  + Feedback regulation
  + Disorders of the endocrine system
  + Approach to the patient with an endocrine disorder
  + Treatment of endocrine disorders that produce a hormone deficiency
* Physiology of the Pancreas - *L.* *Kaufman*
  + Regulation of plasma glucose
  + Factors determining plasma glucose concentration
  + Regulation of insulin secretion (insulin, C-peptide, amylin)
  + The endocrine pancreas and Islets of Langerhans
  + Insulin actions
  + Glucagon secretion & actions
  + Insulin/glucagon ratio
  + Consequences of insulin excess
  + The renal handling of glucose
* Beta Cell Physiology - *Olson*
  + Biochemical mechanism of glucose-stimulated insulin secretion
  + Potentiation and inhibition of glucose-stimulated insulin secretion
  + Transcription factors that regulate pancreatic beta cell development and longevity
  + Maturity Onset Diabetes of the Young and Hyperinsulinemia Hypoglycemia of Infancy
  + Beta cell compensation and dysfunction during insulin resistance and type 2 diabetes
* Physiology of Mineralocorticoids (The Renin-Angiotensin-Aldosterone System, RAAS) - *L.* *Kaufman*
  + Anatomy of the adrenal gland
  + Synthesis of adrenal steroids
  + Renin-angiotensin-aldosterone system (RAAS)
  + Endocrine hypertension
  + Primary aldosteronism (Conn’s syndrome; hyperaldosteronism)
  + Competition for binding to the mineralocorticoid receptor
* Thyroid Physiology - *L.* *Kaufman*
  + The hypothalamic-pituitary-thyroid axis
  + Synthesis, storage, and secretion of thyroid hormones
  + Hyperthyroidism vs. thyrotoxicosis (a matter of semantics)
  + Dietary iodine
  + Peripheral deiodination of T4
  + Hormone transport and metabolism
  + Thyroid hormone mechanism of action
  + Biologic effects of thyroid hormones
* Physiology of Glucocorticoids, Adrenal Androgens - *L.* *Kaufman*
  + Adrenal cortex anatomy, physiology, and regulation of the hypothalamic-pituitary-adrenal axis
  + Clinical assessment of cortisol production
* Physiology of the Adrenal Medulla - *L.* *Kaufman*
  + Control of adrenomedullary catecholamine secretion
  + Hormone vs. neurotransmitter effects of catecholamines
  + Effects of catecholamines
  + Pheochromocytoma – excess catecholamine secretion
* Physiology of Calcium Regulation, Hypercalcemia, & Hypocalcemia - *L.* *Kaufman*
  + Physiology of calcium regulation
  + Hypercalcemia
  + Hypocalcemia
* Bone Physiology and Osteoporosis - *L.* *Kaufman*
  + Bone physiology and metabolic bone disease
  + Osteoporosis
  + Diagnosis, prevention, and treatment of osteoporosis
* Physiology of Reproduction 1: Fundamentals - *Schwartz*
  + Hormone classes, examples, and cognate receptors
  + Steroid hormone-receptor signaling
  + Physiologic actions of testosterone, dihydrotestosterone, and estradiol in the male
  + Androgen receptor mutations – Complete androgen insensitivity syndrome
  + Metabolism, transport, and excretion of androgens
  + Hypothalamic-pituitary-testicular axis
  + Testicular steroidogenesis (Leydig cell testosterone synthesis)
* Physiology of Reproduction 2: Anatomy & Histology of the Male - *Schwartz*
  + Male reproductive anatomy: testis and spermatic cords
  + Seminiferous tubules
  + Intratesticular ducts
  + Extratesticular ducts
  + Histology of the seminiferous tubules
  + Histology of the straight tubules
  + Histology of the rete testis
  + Histology of the efferent ductules
  + Histology of the epididymis
  + Histology of the vas deferens
  + Anatomy of the male urethra
  + Anatomy and histology of the accessory glands
  + Histology of the seminal vesicles
  + Histology of the prostate
  + Prostate physiology
  + Glands of the prostate
  + Clinical zones of the prostate
  + Pathology of the prostate (Benign prostatic hyperplasia, Adenocarcinoma)
  + Histology of the bulbourethral glands
* Physiology of Reproduction 3: Spermatogenesis & Fertility - *Schwartz*
  + Spermatogenesis
  + Spermiogenesis
  + Seminiferous tubule organization
  + Sperm maturation
  + Sperm architecture
  + Blood-testis-barrier
  + Hormones in the hypothalamic-pituitary-testicular axis
  + Leydig-Sertoli cell interactions
  + Causes and evaluation of male infertility
* Physiology of Reproduction 4: Female Reproductive System Anatomy & Histology - *Schwartz*
  + Female reproductive tract structures
  + Histology of the uterine endometrium
  + Anatomy and histology of the cervix
  + Anatomy and histology of the fallopian tubes
  + Anatomy and histology of the ovaries
* Physiology of Growth Hormone, Prolactin, Pituitary Adenomas - *L.* *Kaufman*
  + Anatomy of the anterior and posterior pituitary
  + Negative feedback control of the hypothalamic-pituitary axis
  + Hypothalamic releasing factors (releasing hormones)
  + Pituitary insufficiency
  + Responses of pituitary hormones to insulin-induced hypoglycemia
  + Regulation of growth hormone secretion
  + Direct and indirect effects of growth hormone
  + Growth hormone deficiency
  + Pituitary adenomas
  + Growth hormone excess (gigantism and acromegaly)
  + Effects of pituitary tumors on the visual system
  + Regulation of prolactin secretion
  + Prolactin excess
* Physiology of Reproduction 5: Menstrual Cycle & Hypothalamic-Pituitary-Ovarian Axis - *Schwartz*
  + Menstrual cycle
  + Hormonal changes in the menstrual cycle
  + Endometrial changes in the menstrual cycle
  + Hormonal and endometrial changes
  + Ovarian follicle development
  + Ovulation
  + Corpus luteum
  + Hypothalamic-pituitary-ovarian axis
* Physiology of Reproduction 6: Fertilization - *Schwartz*
  + Fertilization
  + Changes in the oocyte
  + Transit through the fallopian tube
  + Prerequisites for fertilization
  + Pronucleus formation
  + Fusion of pronuclei
  + DNA duplication
  + Potential anomalies
  + Pre-implantation blastocyst
  + Requirements for implantation
  + Implantation
  + Corpus luteum
* Physiology of Reproduction 7: Placental Development - *Schwartz*
  + Characteristics of the placenta
  + Maternal and fetal placenta
  + Chorionic villi
  + Decidua
  + Utero-placental circulation
  + Placental invasion
  + Histology of placenta and chorionic villi

## Semester 4

**OST 531 – Reproductive, Development, and Sexuality**

* Fertilization, Placental Development - *Schwartz*
  + Natal sex, gender identity, and transgender
  + Capacitation, acrosome reaction, and cortical reaction
  + Pronucleus formation
  + Gamete preservation
  + Zygote
  + Blastocyst
  + Cell fate decisions
  + Hormonal priming and receptivity
  + Implantation
  + Placental characteristics
  + Fetal and maternal surfaces
  + Chorionic villi
  + Utero-placental circulation
  + Endovascular trophoblasts
  + Placental invasion
  + Umbilical cord
* Endocrinology of Pregnancy: Maternal Adaptations - *Schwartz*
  + Cardiovascular system
  + Hematologic changes
  + Respiratory system
  + Renal system
  + Thyroid gland
  + Pituitary
  + Nutrient metabolism: pancreas
  + Gastrointestinal system
  + Musculoskeletal
  + Dermatologic
* Parturition, Lactation - *Schwartz*
  + Phases and stages of labor
  + Mechanisms of parturition
  + Stage I lactogenesis
  + Stage II lactogenesis
  + Terminal duct lobular unit
  + Pregnancy and lactation
  + Mammary epithelium
  + Factors influencing milk synthesis

**OST 532 – Integumentary System**

* Role of the Skin in Thermoregulation - *DiCarlo*
  + Temperature-control (thermoregulatory) system brings heat production and heat loss into balance
  + Skin blood flow is adjusted to control heat loss from the body
  + Sweat glands and sweat
  + Physiology of piloerection and shivering

**OST 533 – Gastrointestinal System**

* Physiology: Fundamentals of GI Signaling & Motility - *Schwartz*
  + Enteric nervous system
  + Signaling mediators
  + Gastrointestinal motility
  + Self-instructional problems
  + Answers to self-instructional problems
* Physiology: Fundamentals of GI Secretion - *Schwartz*
  + Overview
  + Salivary gland secretions
  + Gastric secretions
  + Secretions of the exocrine pancreas
  + Biliary secretions
  + Intestinal secretions
  + Cephalic, gastric, and intestinal phases
  + Self-instructional problems
  + Answers to self-instructional problems
* Physiology: Fundamentals of Digestion and Absorption - *Schwartz*
  + Introduction
  + Digestion and absorption of carbohydrates
  + Digestion and absorption of proteins
  + Digestion and absorption of fats
  + Self-instructional problems
  + Answers to self-instructional problems
* Physiology: Advanced Upper GI Motility and Secretion - *Schwartz*
  + Salivary function and secretion
  + Oro-pharyngeal phase of swallowing
  + Esophageal motility
  + Lower esophageal sphincter
* Physiology: Advanced Gastric Motility - *Schwartz*
  + Overview of basic electrical activity
  + Gastric relaxation
  + Gastric contraction
  + Motility disorders
* Physiology: Advanced Gastric Secretion - *Schwartz*
  + Cellular composition of the stomach
  + Gastric acid secretion
  + Regulation of gastric acid secretion
  + Gastric secretions and ulcers
  + Self-instructional problems
  + Answers to self-instructional problems
* Physiology: Advanced Upper GI and Gastric Review - *Schwartz*
  + Motility
  + Contractility
  + Swallowing and esophageal motility
  + Gastric motility
  + Pathology
  + Secretion
  + GI hormones
  + Gastric juice and phases of secretion
  + Salivary gland secretions
  + Pathology
* Physiology: Advanced Fat Digestion and Absorption - *Schwartz*
  + Fat digestion
  + Fat digestion in the stomach and duodenum
  + Actions of pancreatic enzymes on fats
  + Micelle formation
  + Unstirred water layer
  + Summary
  + Importance of bile
  + Fat absorption
  + Uptake into enterocytes
  + Re-esterification
  + Chylomicron formation
  + Summary of digestion and absorption
  + Malabsorption
  + Other Fats
  + Short- and long-chain fatty acids
  + Phospholipids
  + Fat-soluble vitamins
  + Absorption and deficiencies in vitamins A, D, E, and K
  + Lipoprotein transport
  + Circulating lipids and lipoprotein classes
  + Exogenous lipoprotein transport pathway
  + Endogenous lipoprotein transport pathway
  + Reverse cholesterol transport
  + Chylomicron remnants
  + Self-instructional problems
  + Answers to self-instructional problems
* Physiology: Advanced CHO, Protein, B12, digestion and absorption - *Schwartz*
  + Digestion and absorption of carbohydrates
  + Carbohydrate digestion (Case 1)
  + Carbohydrate absorption (Cases 2-3)
  + Digestion and absorption of proteins
  + Protein digestion
  + Protein absorption
  + Vitamin B12 absorption
  + Mechanism of cobalamin absorption
  + Causes of cobalamin deficiency
  + Total parenteral nutrition (Case 4)
  + Effects of aging and lifestyle factors on the GI tract
  + Aging
  + Chronic alcohol consumption
  + Conditions that contribute to malabsorption
  + Self-instructional problems
  + Answers to self-instructional problems
* Physiology: Advanced Pancreatic Secretions - *Schwartz*
  + Embryology of the pancreas
  + Ducts and acini of the exocrine pancreas
  + Regulation of pancreatic secretions
  + Self-instructional problems
  + Answers to self-instructional problems

**OST 553 – Osteopathic Patient Care**

* None

**OMM 513 – Osteopathic Manipulative Medicine**

* None

## Semester 5

**OST 534 – Cardiovascular System**

* Cardiac Action Potential - *DiCarlo*
  + Slow action potentials
  + Fast action potentials
  + Refractory periods
  + Cardiac innervation
  + Effects of autonomic stimulation
* Recording Action Potential/Vectors - *DiCarlo*
  + Measuring electrical activity
  + ECG rules
* Cardiac and Vascular Function - *DiCarlo*
  + Cardiac excitation-contraction coupling
  + Vascular smooth muscle contraction and relaxation
* Mechanical Activity of Heart 1 & 2 - *DiCarlo*
  + Pulsatile pressure changes within the heart
  + Structures and mechanisms that ensure unidirectional blood flow
  + Genesis of heart sounds and murmurs and abnormalities
* Control of Cardiac Output 1 - *DiCarlo*
  + Measurements and determinants of cardiac output
  + Control of heart rate
  + Stroke volume
  + Contractility
* Factors Controlling Blood Flow and Hemodynamics - *DiCarlo*
  + Physical factors that regulate flow
  + Velocity of flow and volume flow
  + Pressure, flow, and resistance in the vascular system
  + Hydrostatic and transmural pressure
* Systemic Circulation - *DiCarlo*
  + Arterial systolic pressure
  + Arterial diastolic pressure
  + Determinants of arterial pulse pressure
  + Determinants of mean arterial blood pressure
  + Changes in arterial compliance
* Microcirculation - *DiCarlo*
  + Capillaries and nutrient exchange
  + Capillary filtration
  + Role of lymphatic vessels
* Blood Volume & Venous Return - *DiCarlo*
  + Central venous pressure
  + Compliance, volume, and nervous control of smooth muscle in arteries and veins
  + Orthostatic hypotension
* Neural & Hormonal Control of Blood Flow, Blood Pressure and Blood Volume - *DiCarlo*
  + Arterial baroreceptor reflex
  + Atrial volume receptor reflex
  + Natriuretic peptides
  + neuro-humoral control of peripheral blood flow
* Circulation to Special Regions - *DiCarlo*
  + Blood flow regulation in the skeletal muscle vasculature
  + Blood flow regulation in the cerebral vasculature
  + Blood flow regulation in the coronary vasculature
  + Blood flow regulation in the cutaneous vasculature
* Integrated Responses – Exercise - *DiCarlo*
  + Cardiovascular response to exercise
  + Initiation and integration of the autonomic response during whole-body dynamic exercise
  + Heat stress
  + Types of exercise and atrial pressure increases
  + Control of coronary blood flow during exercise
* ECG Basics - *DiCarlo*
  + Standard 12-lead ECG
* Cardiac Electrophysiology - *DiCarlo*
  + Changes in ion conductance associated with a ventricular myocyte action potential
  + Sarcolemmal ion pumps and exchangers
  + Components of the ECG trace
  + Relationship of normal action potential and normal ECG
  + ECG rules and principles
  + Subendocardial ischemia versus transmural ischemia
* Vector Person - *DiCarlo*
  + ECG rules
  + Cardiac vectors
* Physiology - Hypertension - *DiCarlo*
  + Systolic, diastolic, and mean arterial blood pressure
  + Pulse pressure
  + Cardiac output, peripheral resistance, and blood volume
* Physiology - Myocardial Ischemia - *DiCarlo*
  + Diastolic dysfunction, systolic dysfunction, and arrhythmia susceptibility during myocardial ischemia
  + Myocardial oxygen supply
  + Myocardial oxygen demand
  + Myocardial oxygen consumption
* Physiology - Congestive Heart Failure - *DiCarlo*
  + Systolic heart failure
  + Diastolic heart failure
* Physiology – Circulatory Shock - *DiCarlo*
  + Mechanisms mediating hypotension
  + Initial compensatory mechanisms for hypotension
* Physiology - Valvular Heart Disease - *DiCarlo*
  + Ventricular pressure-volume loop
  + Ejection fraction
  + The effects of preload, afterload, and contractility on the pressure-volume loop
  + The effects of aortic stenosis, mitral stenosis, aortic regurgitation, and mitral regurgitation on the pressure-volume loop.

**OST 535 – Respiratory System**

* Basic Concepts - *DiCarlo*
  + Basic gas laws
  + Properties of gases
  + Important pressures
* Pulmonary Mechanics - *DiCarlo*
  + The forces involved in respiratory mechanics
  + Inspiration and expiration
  + Compliance
  + Surface tension
  + Airflow
* Pulmonary Ventilation - *DiCarlo*
  + Airway anatomy
  + Ventilatory volumes
  + Measurements of ventilation
* Pulmonary Blood Flow - *DiCarlo*
  + Pulmonary circulation
  + Factors affecting lung pressures: Posture
  + Four-zone model of pulmonary circulation
  + Active and passive factors that regulate pulmonary blood flow
* Pulmonary Gas Exchange - *DiCarlo*
  + Ventilation-perfusion matching and mismatching
  + Pulmonary diffusion
  + Perfusion versus diffusion limitation
  + Factors limiting diffusion
* Gas Transport: Lungs and Periphery - *DiCarlo*
  + The partial pressure of oxygen differences in air and systemic arterial blood
  + Influence of alveolar ventilation on alveolar oxygen and carbon dioxide
  + Solubilities of respiratory gases
  + Concentrations vs. partial pressures of gases dissolved in liquids
  + Physically dissolved oxygen in pulmonary capillary and systemic arterial blood
  + The hemoglobin molecule in oxygen transport
  + Oxyhemoglobin dissociation curve
  + Carbon dioxide transport in the blood
  + Carbon dioxide dissociation curve
  + Hypoxia and hypoxemia
* Control of Ventilation - *DiCarlo*
  + Neural transection studies
  + Effectors and efferent pathways: Muscles
  + Neurogenic reflexes
  + Chemoreceptor reflexes

**OST 554 – Osteopathic Patient Care**

* None

**OMM 514 – Osteopathic Manipulative Medicine**

* None

## Semester 6

**OST 561 – Ambulatory Care Capstone**

* None

**OST 562 – Hospital Care Capstone**

* None

**OST 533 – Health System Science**

* None

**OST 555 – Osteopathic Patient Care**

* None

**OMM 515 – Osteopathic Manipulative Medicine**

* None