Biochemistry Thread Road Map

Thread Director: Raquel Ritchie

Email: rritchie@msu.edu

# Overview

* This thread provides students with a survey of the major biochemical events occurring in normal cells and tissues. This thread also provides students with an understanding of the principal biochemical mechanisms that contribute to normal homeostasis and the inherent capacity of the individual for the maintenance of health and recovery from disease.
* Foundational concepts in Biochemistry are introduced in OST 520 – Foundations of Biomedical Science for Osteopathic Medicine in semester 2. The objective is to establish sufficient familiarity with biochemistry terminology and major biochemical events that occur in normal cells and tissues to facilitate the interpretation and application of these concepts within the systems courses.
* These biochemical concepts will be built upon in the systems courses when describing the basis of disease and its treatment.
* After completion of the preclerkship arc, students will be prepared to demonstrate knowledge of biochemistry on COMLEX-USA Level 1.



# Framework

* Biochemistry: Application of chemistry to the study of biological processes at the cellular and molecular level.

# Semester 1

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

1. Module 8: Biomarkers in blood and urine
	1. Plasma proteins
	2. Proteins that normaly should not be in the plasma
	3. Other serum biomarkers
	4. Urinalysis

# Semester 2a

## OST 520 – Foundations of Biomedical Science for Osteopathic Medicine

1. Hemoglobin and blood transport
	1. Structural composition of heme
	2. Heme bound to carbon monoxide
	3. Heme bound by hemoglobin
	4. Consequences of allosteric effectors on Hb
	5. O2 and CO2 transport using the bicarbonate buffer system
	6. Mechanism of O2 loading and unloading
2. Blood pH regulation
	1. Blood buffers - Key Summary Statements on Henderson-Hasselbalch Equation and on Buffers
	2. Blood bufferes - Principal components of the blood buffering system
	3. blood buffers - The bicarbonate buffer system
	4. Acidosis, Alkalosis and Physiologic Compensation
		1. Terminology and key contributory components
		2. Respiratory parameter
		3. Non-respiratory parameter
		4. Correction vs. compensation of acid-base abnormalities
3. Vitamins
	1. Water soluble vitamins
4. Carbohydrate metabolism
	1. Digestion and absorption
	2. Glycolysis
	3. Entry of other sugars into glycolysis
	4. Pyruvate Dehydrogenase Complex (PDH complex)
	5. Tricarboxylic Acid (TCA) cycle
	6. Electron Transport Chain (ETC)
	7. Gluconeogenesis
	8. Pentose Phosphate Pathway (PPP)
	9. Glycogen metabolism: Glycogenesis (glycogen synthesis)
	10. Glycogen metabolism: Glycogenolysis (glycogen breakdown)
5. Lipid metabolism
	1. Overview of Lipid Metabolism
	2. Fatty acid oxidation (a.k.a. β-oxidation of Fatty Acids)
	3. Ketone body Synthesis
	4. Fatty acid synthesis
	5. Complex lipid synthesis and breakdown
		1. Triacylglycerol and Phospholipid Synthesis
		2. Sphingomyelin and Glycosphingolipid Synthesis
		3. Triacylglycerol and Phospholipid Degradation
		4. Sphingolipid and Glycosphingolipid Degradation
6. One carbon metabolism
	1. one carbon unit flow
	2. tetrahydrofolate/folic acid
	3. S-adenosyl methionine (SAM, AdoMet)
	4. B12 deficiency, megaloblastic anemia
7. Nucleotide metabolism
	1. Purine nucleotide biosynthesis
	2. pyrimidine nucleotide biosynthesis, orotic aciduria
	3. deoxynucleotide biosynthesis, 5FU and methotrexate
	4. catabolism of purines, uric acid
	5. salvage pathways for purines
	6. hyperuricemia and gout, Lesch-Nyhan
8. Hormones and hormone actions in metabolism
	1. Insulin
	2. Glucagon
	3. Fed state
	4. Starved state

# Semester 2b

## OST 522 – Hematology, Oncology, and Infectious Disease

1. Iron Metabolism
	1. Normal/abnormal RBC sizes, color, & shape
	2. Microcytic anemia, hypochromic anemia
	3. Hb; Fe oxidation; heme & non-heme iron
	4. Iron carriers, transport, and absorption
	5. Ferritin, ferroportin, hepcidin, transferrin, apotransferr.
	6. CBC; TIBC, UIBC, % transferrin saturation
	7. Hemochromatosis; hemosiderosis
2. Heme Metabolism
	1. Heme structure, steps in heme biosynthesis
	2. Porphyria, defective enzymes, lead poisoning
	3. Heme catabolism; conjugated/non conj bilirubin
	4. Indirect/tl bilirubin; hemolytic/physiologic jaundice
3. Red blood cell (RBC) Metabolism
	1. O2-Hb;NAD+; HMP shunt; 2-3DPG; metHb
	2. Glycolysis, oxidat phosphn; HMP shunt GSSG/mutns
	3. PK deficiency, G6DH deficiency; Heinz bodies; metHb
	4. Thalassemia; sickle cell; cyanosis; congenital anemia
4. Hemostasis
	1. Hemostasis; coagulation cascade; fibrin clot formation

# Semester 3b

## OST 525 – Genitourinary System

1. Protein Metabolism
	1. Protein Nutrition (N Balance)
	2. Protein Digestion & Metabolism
	3. Amino Acid Metabolism
	4. Clinical Application – Case Session
2. Self-Study Acid-Base Review

## OST 526 – Endocrine System

1. Cholesterol and Lipid Metabolism
	1. Cholesterol Synthesis and Bile Acids
	2. Digestion, Absorption, Transport, Delivery of Lipids 1
	3. Digestion, Absorption, Transport, Delivery of Lipids 2
2. Hormones and hormone actions in metabolism
	1. Hormones 1
	2. Hormones 2
3. Fed, Starved and Diabetic State

# Semester 5

## OST 534 – Cardiovascular System

1. Biochem - Lipids 1
	1. Transport and delivery of lipids
	2. Overview of lipids
	3. Lipid transport pathways - via plasma lipoproteins
2. Biochem - Lipids 2
	1. Lipid delivery to tissues
	2. Energy metabolism in the heart
	3. Clinical considerations