

MED1103: Biomolecules & Metabolism Module - 2015/16 Batch

Year 1 Semester 1

Credits: 4

Responsible Department: Biochemistry

Module Coordinator: Dr. S. P. R. P. Prematilake

Topic	Time	Objectives	T/L activity	Comments
1 Cell				
1.1 Introduction to water and biomolecules	1hr	<ol style="list-style-type: none">1. state the properties of water which enables it to be the major constituent of cell and its environment2. state what is meant by "hydrophilic", "hydrophobic" and "amphipathic", and provide examples for each3. define "macromolecules" and "monomers"4. name the macromolecules found in the human body5. state the significance of interactions that occur within biomolecules, between biomolecules, and between biomolecules and water	Lecture (1hr)	
1.2 Biochemical role of the cell	1hr	<ol style="list-style-type: none">1. describe the biochemical functions of the fundamental unit of life (cell)2. describe the biochemical role of cell organelles3. state that the proper functioning of cell organelles is important to smooth cell function	Lecture (1hr)	

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1.3 Membrane	1hr	describe the basic structure & functions of the cell membrane	Lecture (1hr)	PD 1 on membrane and lipids.
1.4 Biomolecules	11hrs	describe the role (with respect to structure and function) of biomolecules a. Carbohydrates b. Amino acids c. Proteins d. Lipids e. Mucopolysaccharides	Lecture (1hr) Lecture (1hr) Lecture (1hr) Lecture (1hr) Lecture (1hr) PD (2 x 3hrs)	PD 2 on carbohydrates, amino acids and proteins.
2 Enzymes & their activity				
2.1 Enzymes	11hrs	1. describe what an enzyme is and the functions of enzymes in the body 2. recall how the structure of protein contribute to function of an enzyme 3. explain the mode of action of enzymes in terms of an active site, enzyme/substrate complex, lowering of activation energy and enzyme specificity 4. explain and investigate the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme action 5. follow the time course of an enzyme-catalysed reaction, by measuring rates of formation of products or rate of disappearance of substrate (example amylase) 6. briefly describe the terms V_{max} and K_m 7. explain the effects of competitive and non-competitive inhibitors on the rate of enzyme activity 8. define the term allosteric enzymes and isozymes	Lectures (2hrs) PD (2 x 3hrs)	State the application of knowledge on enzymes in Medicine (deficiency, disease diagnosis and as target of drugs). SGD is on topics 2.1 and 2.2.
2.2 Regulation of enzyme activity		describe the regulation of enzyme activity in terms of <ul style="list-style-type: none"> • Induction/ repression • Allosteric modification • Covalent modification 	Lecture (1hr) SGD (2hrs)	

3 Energy for the cell				
3.1 Introduction to the Energy for the cell	11hrs	1. state the need of energy for cellular activity 2. state the molecules and the mechanisms involved in the energy production	Lecture (1hr)	PD and SGD are on all topics from 3.1 to 3.6.
3.2 Glycolysis		1. state the biomedical importance of glycolysis 2. outline the glycolytic pathway and its rate limiting steps 3. define the term substrate level phosphorylation 4. describe the difference between aerobic and anaerobic glycolysis 5. outline the regulation of glycolysis	Lecture (1hr)	
3.3 TCA Cycle		1. explain the amphibolic role of the pathway (plays a role in both oxidative and synthetic pathways) 2. describe the TCA Cycle as an integrated pathway in metabolism 3. list the enzymes and co enzymes of the TCA cycle 4. describe the entry of fatty acids, pyruvate and amino acids into the TCA cycle 5. explain how the pathway is regulated	Lecture (1hr)	
3.4 Oxidation of Amino acids		1. describe how amino acids are oxidized to produce energy (including transamination and oxidative deamination) 2. state the difference between glucogenic and ketogenic amino acids	Lecture (1hr)	
3.5 Oxidation of fatty acids		1. outline the main events taking place during oxidation of fatty acids 2. describe how the oxidation of fatty acids is regulated 3. explain the difference in the energy yield based on different biomolecules	Lecture (1hr)	
3.6 Electron transport chain		1. state the function of the electron transport chain 2. describe the components of the electron transport chain 3. describe how ATP is generated during electron transport 4. state the final electron acceptor and the end product formed at the end of aerobic respiration	Lecture (1hr) PD (3hrs) SGD (2hrs)	

		5. state the site specific inhibitors (CN, CO, H ₂ S, NaN ₃ , Antimycin A) of electron transport chain		
3.7 Energy for the muscle	2hrs	<ol style="list-style-type: none"> 1. name different types of muscle and state the adaptations available for their function 2. state the major fuels used by skeletal muscle and describe the environment present to promote energy production (pH, temperature, electrolytes) 3. describe the status of ATP/ADP ratio in a skeletal muscle fiber when it is resting and active, explaining how the ratio affects energy production under aerobic and anaerobic (hypoxic) conditions 	Lectures (2hrs)	This lecture needs to be timed after corresponding lectures by the department of physiology.
4 Other hexose metabolic pathways				
4.1 HMP Shunt	1hr	<ol style="list-style-type: none"> 1. outline the pathway and its rate limiting step 2. explain the role of the HMP shunt in different cells/ tissues 3. explain the metabolic consequences of G6PD deficiency 	Lecture (1hr)	
4.2 Metabolism of other carbohydrates	1hr	outline the processes involved in the synthesis of fructose, galactose and lactose	Lecture (1hr)	
5 Synthesis of important biomolecules				
5.1 Gluconeogenesis	14hrs	<ol style="list-style-type: none"> 1. define gluconeogenesis 2. explain how gluconeogenesis is regulated 3. explain how it differs from glycolysis 4. explain the biological role of gluconeogenesis 	Lecture (1hr)	SGD is on all topics from 5.1 to 5.4.
5.2 Glycogen metabolism		<ol style="list-style-type: none"> 1. describe the main events of glycogenesis 2. describe the main events of glycogenolysis 3. explain how glycogen metabolism is regulated 4. state the importance of liver glucose-6-phosphatase in the maintenance of blood glucose level 	Lecture (1hr)	

5.3 Simple and complex lipids	<ol style="list-style-type: none"> 1. outline the process of fatty acid synthesis 2. state how fatty acid synthesis is regulated 3. state the main steps of cholesterol synthesis 4. state how cholesterol synthesis is regulated 5. state the effect of statins on cholesterol synthesis 	Lecture (2hrs)	
5.4 Ketone bodies metabolism	<ol style="list-style-type: none"> 1. name the "ketone bodies" 2. state why ketone bodies are synthesized and outline ketone body synthesis 3. state the tissues involved in metabolism of ketone bodies 4. explain the importance of ketone bodies in energy production 5. state the circumstances where ketone body formation is increased 	Lecture (1hr) SGD (2hr)	
5.5 Purines & pyrimidines	<ol style="list-style-type: none"> 1. state the components of nucleic acids 2. state the precursors of purines and pyrimidines 3. describe the role of PRPP in purine and pyrimidine metabolism 4. explain how the purine and pyrimidine syntheses are regulated 5. state how AMP, GMP, PABA analogs, folic acid analogs, mycophenolic acids, allopurinol and nucleotide analogs affect purine and pyrimidine metabolism 	Lecture (1hr)	SGD is on topics 5.5 and 5.6.
5.6 Proteins	<ol style="list-style-type: none"> 1. state how the genetic information is conveyed to a protein 2. describe the process of transcription 3. describe the process of post-transcriptional modifications and its importance 4. state the different types of RNA 5. describe the properties of the genetic code 6. describe the process of translation 7. describe the process of post-translational modifications and its importance 8. list the differences between prokaryotic and eukaryotic protein synthesis 9. explain the effect of antibiotics (aminoglycosides, tetracyclins, chloramphenicol, macrolides, clindamycin, fusidic acid) on protein synthesis 	Lecture (3hrs) SGD (2hrs)	

5.7 Collagen		<ol style="list-style-type: none"> 1. state the basic steps involved in collagen synthesis (including post-translational modifications) and their defects 2. state different types of collagen and their distribution 3. explain the biochemical basis of diseases related to collagen 	Lecture (1hr)	
6 Homeostasis				
Regulation of metabolism	2hrs	<ol style="list-style-type: none"> 1. state the effect of insulin, glucagon, cortisol, epinephrine on enzymes in regulation of energy metabolism 2. recall the regulatory functions of the following; hexokinase, glucose 6-phosphatase, phosphofructokinase, fructose diphosphatase, pyruvate dehydrogenase, pyruvate carboxylase, citrate synthase and isocitrate dehydrogenase, acetyl CoA carboxylase, HMG CoA reductase, aspartate carbamoyltransferase and phosphoribosyl pyrophosphate amino transferase 	Lectures (2hrs)	
7 Vitamins and minerals in metabolism: Nutritional Biochemistry – I				
7.1 Water-soluble vitamins	8hrs	<ol style="list-style-type: none"> 1. name the water-soluble vitamins 2. describe the biochemical functions of the vitamins 3. state the requirements, sources and availability (internal and external factors) 4. describe the effects of deficiency 	Lectures (2hrs)	(emphasis will be given with respective modules for the following: role of iron on red cell(1208) calcium and fluoride on bone(2112) iodine on thyroid (2112) SGD is on all topics from 7.1 to 7.3.
7.2 Fat-soluble vitamins		<ol style="list-style-type: none"> 1. name the fat-soluble vitamins 2. describe the biochemical functions of the vitamins 3. state the requirements, sources and availability (internal and external factors) 4. describe the effects of deficiency and excess 	Lectures (2hrs)	

7.3 Minerals		<ol style="list-style-type: none"> 1. describe the biochemical functions of minerals 2. state the requirements, sources and availability (internal and external factors) 3. describe the effects of deficiency and excess calcium, phosphorus, zinc, chromium, manganese, magnesium, selenium, fluoride, cobalt, copper, iron, iodine 	<p>Lectures (2hrs)</p> <p>SGD (2hrs)</p>	
8 Student-centered learning activity	6hrs	Present and discuss the key areas that were learnt during the module	Student presentations (6hrs)	<p>Holistic approach on the module.</p> <p>Revision of major topics by presentation and discussion to improve the student centered learning.</p>

