

# Endocrine Function, Homeostasis, and Metabolism Module - 2014/15 Batch

Year 2 Semester 1 – Time SBM [58 (L) + 13(CCR – 5 +SGD - 8)] = 71 hours CLM 23 hrs (total 94 hrs)

Module Coordinator Dr. P.H.P. Fernando

Topic	Time	Objectives	Dept	Resp Person	T/L activity
<b>2013-2/SBM-8/1 Introduction</b>	1 hr	<b>Student should be able to:</b> 1. Explain the significance of homeostasis. 2. Explain the role of the Endocrine system in relation to homeostasis and metabolism 3. Understand the importance of endocrinology in Medicine	Medicine	Head/ Medicine	Lecture 1 hr
<b>Homeostasis</b>		1. Explain the term “internal environment” 2. Explain the role of organ systems in maintaining homeostasis 3. Explain the characteristics of feedback systems Recall from Foundation Module 2008-1/SBM 1/12 b			
<b>Body Fluids</b>  <b>a. Body fluid compartments</b>		1. Recall the composition of the body in terms of body water, lean body mass and body fat and describe variations in body composition with age and sex. 2. Recall the body fluid compartments and state the percentages of water, concentration of electrolytes and osmolalities of each compartment 3. List the routes of fluid intake and output and recognize that in health, intake equals output. 4. Recognize that the regulatory mechanisms are adjusted to maintain the internal environment constant (homeostasis) 5 Explain the basis for compartmentalization in terms of the following: cell membrane structure and permeability characteristics osmosis, diffusion and facilitated diffusion, and active transport			
<b>b. Neurohumoral regulation of ECF volume</b>		1 Recall the regulatory mechanisms which maintain extracellular fluid (ECF) Volume with reference to: renin- angiotensin -aldosterone mechanism , osmo receptors and antidiuratic hormone (ADH), thirst mechanism, atrial natriuretic peptide (ANP), low pressure stretch receptors ("volume reflex")			

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<p><b>a. pH</b></p> <ul style="list-style-type: none"> <li>. Concept of pH</li> <li>. Buffers</li> <li>. Regulation of pH</li> </ul> <p><b>b. Acid Base Balance</b></p> <p><b>Anion gap</b></p> <p><b>c. Electrolyte imbalance and its effects</b></p>		<ol style="list-style-type: none"> <li>1. Recall the terms pH and buffers.</li> <li>2. State the normal body pH and variations in health</li> <li>3. Explain the terms acidosis, alkalosis, acidaemia and alkalaemia</li> <li>4. Explain the basis of the Henderson-Hasselbalch equation</li> <li>5. Explain the term acid-base buffer system</li> <li>6. Explain the function of the following buffer systems <ul style="list-style-type: none"> <li>bicarbonate</li> <li>phosphate</li> <li>protein , ammonia</li> </ul> </li> </ol> <ol style="list-style-type: none"> <li>1. Explain the terms: respiratory acidosis and alkalosis, metabolic acidosis and lkalosis, indicate the causes of each abnormality and explain the basis of the pH-bicarbonate diagram</li> <li>2 Be able to calculate the normal anion gap <ul style="list-style-type: none"> <li>List causes of raised anion gap metabolic acidosis.</li> <li>List causes of normal anion gap metabolic acidosis</li> <li>State the compensatory mechanisms that occur in the above conditions.</li> <li>Explain the basis of clinical effects in the conditions listed</li> </ul> </li> </ol> <p>Describe the causes and effects of</p> <ul style="list-style-type: none"> <li>Hypo and hypernatraemia</li> <li>Hypo and hyperkalaemia</li> <li>Hypo and hypercalcaemia</li> <li>Hypo and hypermagnaesemia</li> </ul>			
<p><b>2013-2/SBM-8/2</b></p> <p><b>Thermoregulation</b></p> <p><b>a. Introduction</b></p>	1 hr	<ol style="list-style-type: none"> <li>1. Recognise that man is a homeothermic animal.</li> <li>2. Explain what is meant by normal body temperature.</li> <li>3. State the methods and the sites of measurement of core and superficial temperatures of the body.</li> <li>4. Describe the routes of heat gain and heat loss</li> <li>5. Discuss the factors affecting heat gain and heat loss</li> </ol> <p>State the percentages of heat loss from the different routes in a thermoneutral environment and discuss the changes that take place in different thermal environments.</p>	Physiology	Head/ Physiology	Lecture 1 hr
<p><b>2013-2/SBM-8/3</b></p> <p><b>b. Mechanisms of regulation of body temperature</b></p>	2 hr	<ol style="list-style-type: none"> <li>1. Explain the role of sweating, vasodilatation and shivering in maintaining body temperature.</li> <li>2 Explain the role of non-shivering thermogenesis in heat balance in infants.</li> <li>3. Describe the role of behavioral factors in the control of body</li> </ol>	Physiology	Head/ Physiology	Lecture 2 hr

		temperature. 4. Explain the role of the hypothalamus in body temperature regulation.			
<b>2013-2/CLM-8/1</b> <b>c. Measurement of body temperature</b>	2 hr	1. Measure oral and axillary temperature using a clinical thermometer 2. Measure temperature at different sites (ear drum, axilla, skin)	Physiology	Head/ Physiology	Practical 2 hr
<b>d. Structure and function of the skin</b>		1 Describe the structure of the skin 2 Correlate the structure of the skin with its function. 3. Identify the layers of skin, under the light microscope. 4. List cell types found in epidermis and describe their functions, including: keratinocytes, melanocytes, Langerhan cells, and Merkel cells. 5. Compare thick skin and thin skin giving examples 6. Describe the appendages of the skin. 7. Name and state the functions of the sensory receptors of the skin.			
<b>Role of Vitamins and Minerals in metabolism</b>		1. Describe the role of fat-soluble vitamins in various biochemical reactions. 2. Describe the role of water-soluble vitamins as cofactors of metabolic events. 3. Describe the role of minerals in various functions. E.g.: Structural (Ca, P), membrane (Na, K), Catalytic: as prosthetic groups in enzymes (Fe, Cu), regulatory Ca, Se			
<b>2013-2/SBM-8/4</b> <b>2013-2/CLM-8/2</b> <b>Functional organization of the endocrine system</b> a. General characteristics; chemical messengers b. Structure of hormones	4 hr	1. Recognise that the endocrine system is concerned with regulation of different metabolic functions of the body. 2. Recognise that there is a close interaction between the two control systems of the body, viz. the nervous system and the endocrine system. 3. Define the term 'hormone'. 4. List the biochemical types of hormones. 5. What is a signal transduction pathway ? 6. Explain hormone-receptor interaction and list the sites of hormone receptors. 7. Explain the mode of actions of a steroid hormone and a peptide hormone.	Biochemistry	Head/ Biochemistry	Lecture 2 hr SGD 2 hr

		<p>8. Explain giving examples the terms: local hormones and general hormones.</p> <p>9. Explain the terms first messenger and second messenger and explain the role of G proteins, cyclic AMP, cyclic GMP, Tyrosine kinase, Ca<sup>2+</sup>, and other second messenger systems in controlling cell function.</p> <p>10. List the hormones of the following: Hypothalamus, Pituitary, Thyroid, Parathyroid, Adrenal cortex and medulla, Gonads and placenta, Endocrine pancreas Gastrointestinal system, Kidney, Heart and vascular endothelium, Pineal gland</p>	Physiology	Head/ Physiology	Lecture 1 hr
c. Basic structure and development of endocrine organs	6 hr	<p><b>Endocrine System</b></p> <p>1. State the differences between exocrine and endocrine glands.</p> <p><b>Pituitary gland</b></p> <p>1. State the component parts of the pituitary gland. 2. Describe the hypothalamo- hypophysio portal system. 3. Describe the neurovascular connections between hypothalamus and pituitary. 4. Describe and identify the light microscopic appearance of the pituitary gland. 5. State the cell types and the functions of the cells in the in the anterior and posterior pituitary.</p> <p><b>Thyroid Gland</b></p> <p>1. Describe the gross anatomy of the thyroid gland 2. Describe and identify the light microscopic appearance of the thyroid gland 3. Describe the blood supply of the thyroid gland</p> <p><b>Adrenal Gland</b></p> <p>1. Describe the gross anatomy of the adrenal gland 2. Describe the light microscopic appearance of the adrenal gland 3. Describe the blood supply of the adrenal gland</p> <p><b>Endocrine Pancreas (Islets of Langerhans)</b></p> <p>1. Recall the gross anatomy and the blood supply of the pancreas 2. Recall the light microscopic appearance of the pancreas 3. State the different cell types, present in the islets of Langerhans and their functions</p>	Anatomy	Head/ Anatomy	Lecture 2 hr – Structure of glands

		<b>Development of the endocrine glands</b> 1. Describe the development of the pituitary gland. 2. Describe the development of the thyroid gland 3. Describe the development of the adrenal gland 4. State the development of islets of Langerhans			Lecture 1 hr – development of glands  Practical 3 hr
<b>2013-2/SBM-8/5 Imaging of the endocrine system</b> <b>2013-2/SBM-8/6 Pituitary and hypothalamus</b> a. Structure and relations b. Hormones - biochemistry c. physiology - control	2 hr	Be aware that endocrine organs can be imaged for evaluation of structure and function	Radiology	Head/ Radiology	Lecture demonstration 2 hr
	5 hrs	<b>Student should be able to:</b> <b>Hypothalamus and Pituitary (Anterior and Posterior)</b> 1. Recognise that the hypothalamic factors/hormones are synthesised in hypothalamic neurones, transported via axons and secreted at nerve endings in posterior pituitary. 2. List the hypothalamic releasing factors/ hormones involved in regulating the secretions of the anterior pituitary gland.. 3. Describe the functions of each of these hormones. 4. Explain the mechanisms of regulation of the hypothalamic hormones. 5. Describe the modes of transport of these hormones in the blood. 6. Describe the function of the hypothalamo-hypophysial portal system. 7. State the different types of cells responsible for their secretion. 8. Describe their actions on target tissues, glands and organs. 9. Describe the regulation of secretion of Anterior pituitary hormones 10. Describe the role of somatomedins in mediating the actions of growth hormone. 11 List the hormones of the posterior pituitary gland 12 Describe their synthesis and transport to the post pituitary gland 13 Describe their actions on target tissues, glands and organs 14 Describe the regulation of these hormones	Biochemistry	Head/ Biochemistry	Lecture 1 hr
			Physiology	Head/ Physiology	Lecture 4 hr
<b>2013-2/SBM-8/7 Hypopituitarism and hyperpituitarism</b>	1 hr	1 Describe the effects of hypo and hyper secretion of the hormones secreted by the pituitary gland 2 Describe the effects of the enlargement of the gland	Physiology	Head/ Physiology	Lecture 1 hr
<b>2013-2/SBM-8/8</b>	2 hr	1 Recall the gross anatomy of the thyroid gland			



cortical axis		7. Describe how they are transported in blood 8.State the cyclical pattern of secretion of glucocorticoids and their regulatory hormones. 9.Describe the effects of each of the adrenocortical hormones			
<b>Endocrinology of control of blood pressure</b>		Explain how endocrine dysfunction leads to abnormal blood pressure			
<b>2013-2/SBM-8/11 Adrenal medulla</b> a. Functional anatomy b. Biochemistry of hormones	2 hr	1. List the catecholamines secreted by the adrenal medulla and outline the steps in their biosynthesis 2. Describe the actions of the catecholamines including the effect on metabolism. 3. List the principal metabolites of adrenaline and noradrenaline  1.List the stimuli which increase adrenal medullary secretions 2.Recall the features of the 'fight or flight' reaction 3.Discuss the interaction between the adrenal medullary hormones and the sympathetic nervous system	Biochemistry  Physiology	Head/ Biochemistry  Head/ Physiology	Lecture 1 hr  Lecture 1 hr
<b>2013-2/SBM-8/12 Derangement of adrenal function</b>	1 hr	Describe the clinical features and their physiological basis in hyper and hypo function of the adrenal gland	Physiology	Head / Physiology	Lecture 1 hr
<b>2013-2/SBM-8/13 Endocrine pancreas</b> a. Functional anatomy b. Hormones	7 hr	1.Recall the gross anatomy of the pancreas 2.Recall the functional components of the pancreas 3.Recall the blood supply of the pancreas 4.Recall the microscopic anatomy of the pancreas 5.Recall the features of islets of Langerhans 6.Recall the embryological origin of islets of Langerhans 7.List the hormones secreted by the pancreatic islets 8List the steps involved in the biosynthesis and secretion of insulin 9.Describe the insulin receptor. 10 Describe the effects of insulin on the cell. 11 List the cells which do not require insulin for glucose uptake 12 Describe the effects of insulin on carbohydrate, fat and protein metabolism and growth 13 Explain the control of insulin secretion 14 Describe the functions and regulation of secretion of glucagons 15. Describe the physiological effects of somatostatin and pancreatic polypeptide	Biochemistry	Head/ Biochemistry	Lecture 2 hr  CCR 5 hrs (2+2+1 hrs)
<b>2013-2/SBM-8/14 Glucose</b>	2 hr	1.Explain the role of liver, intestines, kidney, brain, adipose tissue and muscles in glucose homeostasis	Biochemistry	Head/ Biochemistry	Lecture 2 hr

<b>homeostasis</b>		2 Discuss the role of hormones in glucose homeostasis  3. Describe the mode of action of insulin, insulin receptor and glucose transporters			
<b>2013-2/SBM-8/15 Derangement of glucose metabolism</b>	1 hr	1. Describe the causes of hyper and hypoglycaemia 2. Describe the effects of hyper and hypoglycaemia on different organs and tissues	Biochemistry	Head/ Biochemistry	Lecture 1h
<b>2013-9/CLM-8/3 Tests for glucose homeostasis</b>	3 hr	1. Measure glucose in blood and urine 2. Test for ketone bodies in urine 3. Interpretation of laboratory reports	Biochemistry	Head/ Biochemistry	Practical 3 hr
<b>2013-2/SBM-8/16 2013-2/CLM-8/4 Derangement of Glucose homeostasis</b>	7 hrs	Define and explain, Impaired glucose tolerance Impaired fasting glucose Diabetes, Diabetic ketoacidosis Describe the laboratory diagnosis of the above conditions Describe the oral glucose tolerance test Describe the significance of the analysis of glycated Hb in blood and microalbumin in urine	Biochemistry	Head/ Biochemistry	Lecture 2 hr SGD 2 hr Practical 3hr
<b>2013-2/SBM-8/17 Glucose homeostasis</b>	1 hr		Physiology	Head/ Physiology	Lecture 1 hr
<b>Gonadal Hormones</b>		1 Recall the gonadal hormones and state the sources from which they are secreted. 2 Recall the effects of Testosterone, Oestrogens and Progesterone on primary and secondary sexual organs and the rest of the body			
<b>2013-2/SBM-8/18 Other hormones</b>	3 hr	1. Describe the role of the gut, kidney, heart, pineal gland and vascular endothelium as endocrine organs	Physiology	Head/ Physiology	Lecture 3 hrs
<b>2013-2/SBM-8/19 Endocrine function and dysfunction</b>	3 hrs	Round up on endocrine function  Round up on endocrine dysfunction	Physiology  Medicine	Head/ Physiology Head/ Medicine	2 hr SGD  1 hr Lecture
<b>2013-2/SBM-8/20 Measurement of Endocrine Function</b> a. Quantitative tests b. Functions of target organs c. Suppression and stimulation tests	5 hr	List the biochemical investigations used to assess the functions of the endocrine organs List dynamic endocrine tests Be able to interpret the results of the above tests	Medicine	Head/ Medicine	Lecture demonstration 2 hr
<b>2013-2/CLM-8/5 Basis of Testing endocrine function</b>		<b>Student should be able to:</b> 1. List the tests which are based on	NMU	Head/ NMU	3 hr Practical Demonstration

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		<p>a. negative feedback mechanism  b. measurement of serum levels of the hormones  c. measurement of by-products of hormones</p> <p>2. Explain the physiological basis of interpretation of the above tests</p>			
<p><b>2013-2/SBM-8/21</b>  <b>2013-2/CLM-8/6</b>  <b>Thyroid function Tests</b></p>	3 hrs	Interpret deranged thyroid function test results (T3 T4 TSH, Iodine up take studies)	NMU	Head/NMU	Lecture 1 hr Practical 2 hr
<p><b>2013-2/SBM-8/22</b>  <b>2013-2/CLM-8/7</b>  <b>Disorders of lipid metabolism, Mechanisms of dyslipidaemias Classification Effects on target organs</b></p>	4 hrs	<p>Describe the derangements of lipid metabolism, and their molecular basis  Classify the lipid disorders according to the molecular defect  Describe the effects on target organs</p>	Biochemistry	Head/ Biochemistry	Lecture 2 hr Practical 2 hr
<p><b>2013-2/SBM-8/23</b>  <b>2013-2/CLM-8/8</b>  <b>Obesity</b></p>	5 hrs	<p>Impact of obesity on health  Know the Prevalence</p> <p>Describe the biology of obesity, brown adipose tissue (BAT) and white adipose tissue (WAT)- Distribution, Cells &amp; fat, Thermogenesis in BAT)</p> <p>Adipocyte function- Energy regulation via endocrine, paracrine and autocrine signals (Signals include: Leptins, Agouti, Eicosanoids, Angiotensin II), Leptin concentration &amp; Obesity  Other protein signals Eg. Adiponectin, Resistin, IL-6 , TNFa</p> <p>Adiponectin &amp; resistin and insulin sensitivity /resistance</p> <p>Distribution of fat in the body- Central distribution, Peripheral distribution, Waist: hip circumference</p> <p>Treatment- Role of dietary composition, Effect of exercise  Prevention  Complications of obesity</p>	Biochemistry	Head/ Biochemistry	Lecture 3 hr Practical 2 hr

<b>2013-2/SBM-8/24 DNA Organization and Replication, RNA Organization &amp; Transcription and Regulation of gene expression</b>	3 hr	<ol style="list-style-type: none"> <li>1. Describe the organization of DNA</li> <li>2. Describe the process of replication.</li> <li>3. Describe the organization of RNA</li> <li>4. Describe the process of transcription.</li> <li>5. Explain why regulated expression of genes is required.</li> <li>6. Describe how the gene expression is regulated</li> </ol>	Biochemistry	Head/ Biochemistry	Lecture 3 hr
<b>2013-2/SBM-8/25 Protein synthesis, effect of antibiotics on protein synthesis, Post translational Modifications</b>	2 hr	<ol style="list-style-type: none"> <li>1. Describe the properties of the genetic code.</li> <li>2. Describe the steps involved in protein synthesis.</li> <li>3. List the differences between prokaryotic and eukaryotic protein synthesis.</li> <li>5. Explain the effect of antibiotics on protein synthesis</li> </ol> <ol style="list-style-type: none"> <li>1. Describe the post-translational modifications that occur on nascent proteins</li> <li>2. State the importance of these modifications</li> <li>3. Describe the relevance of these modifications in the formation of functional proteins</li> </ol>	Biochemistry	Head/ Biochemistry	Lecture 2 hr
<b>2013-2/SBM-8/26 Gene expression</b>	2 hr	<ol style="list-style-type: none"> <li>1. Explain how the information required for life is carried in genes.</li> </ol>	Biochemistry	Head/ Biochemistry	SGD 2 hr
<b>2013-2/SBM-8/27 Inborn errors of metabolism</b>  <b>Basis of inborn errors of metabolism</b>  <b>Derangements of amino acid metabolism</b>	3 hrs	<p>Explain the genetic causes of inborn errors</p> <p>Explain the phenylalanine metabolism and its derangements List the types of amino acidurias Describe their effects on normal function</p>			Lecture 1 hr

<p><b>Derangements of carbohydrate metabolism</b></p> <p><b>Derangements of lysosomal function And mucopolysaccharide metabolism</b></p> <p><b>Derangements in porphyrin synthesis</b></p> <p><b>Derangements in Nucleic acid metabolism</b></p>		<p>Describe the causes and effects of the derangements of fructose and galactose metabolism Describe the causes and effects of the derangements glycogen metabolism</p> <p>Describe the effects of such derangements on organs and tissues Describe the molecular basis of the derangement of lysosomal function. Describe the different types of mucopolysaccharides, their metabolism, derangements in metabolism, and methods of detection of such changes Describe the effect on tissues and organs.</p> <p>Describe the derangement in porphyrin synthesis and their effects</p> <p>Explain how the normal metabolism of nucleic acids can be deranged Explain the effect of the accumulation of adenosine/deoxyadenosine, uric acid, xanthine and hypoxanthine in blood</p>	Biochemistry	Head/ Biochemistry	Lecture 1 hr
<p><b>2013-2/SBM-8/28</b> <b>2013-2/CLM-8/9</b> <b>Molecular methods in Medicine</b></p>	6 hrs	<p>Describe the basis of the laboratory diagnostic methods available for perinatal detection of IEM Describe the basis of methods available for screening for defective genes Describe how DNA is isolated from tissues for genetic analysis</p>	Biochemistry	Head/ Biochemistry	Lecture 3hrs  Practical 3 hrs
<p><b>2013-2/SBM-8/29</b> <b>Production of hormones by recombinant DNA technology</b></p>	1 hr	<p>Describe the basis of the method involved in the production of human insulin by recombinant DNA technology</p>	Biochemistry	Head/ Biochemistry	Lecture 1 hr