Respiration and Gas Exchange Module - Year 1 Semester 1 Credits – 3

Duration: 04 Weeks (20 days)

Topics/concepts	Objectives	Time	T/L activity	Responsible Department
	At the end of the module, the student should be able to;			
2008-1/1/SBM-2/1				
Regional and cross-sectional anatomy of the thorax: a. Osteology and surface marking b. Chest wall (anterior thoracic wall) c. thoracic cavity and pleura d. Lungs and Airways e. Diaphragm f. Development g. Cross-sectional Anatomy	**a. Osteology and surface marking** 1. Identify and orientate the bones that form the thoracic cage 2. State the boundaries of the thoracic inlet outlet 3. State and demonstrate the bony landmarks of the thorax 4. Count the ribs and intercostals spaces and demonstrate the surface markings of the lungs and pleura **b. Chest wall (anterior thoracic wall)** 1. Describe the arrangement of the muscles of the chest wall 2. Describe the arrangement of structures in the intercostal space 3. Describe the movement of the chest wall during respiration and state its mechanism 4. Describe the blood supply, nerve supply and lymphatic drainage of the chest wall and intercostals spaces 5. Draw and label the dermatomes of the chest wall **c. Thoracic cavity and pleura** **1.** Describe the boundaries of the mediastinum and its divisions **2.** Describe the anatomy of the pleura and pleural cavities **3.** Surface mark the pleura and lungs 4. State and describe the common clinical problems of the thoracic cavity (pleural effusion, pneumothorax, haemothorax) 5. Describe the anatomical basis of the pleural tap and surgical approaches to the thorax **d. Lungs and Airways** 1. Identify the lungs and parts of the airways 2. Describe the bronchial tree and bronchopulmonary segments 3. Describe and identify the microscopic structures of the lungs and	3hrs 1hr 6hrs 3hrs 1 hr 3hrs	Practical Lecture Dissection dissections lecture Dissection	Anatomy Anatomy Anatomy Anatomy Visiting Lecturer Anatomy

	bronchial tree 4. Correlate the structure of lungs and airways with its function 5. Describe the blood supply, nerve supply and lymphatic drainage of lungs and airways 6. Identify lungs and airways in relation to other structures in the thoracic cavity 7. Describe the surface projections of the apex of the lungs and the fissures of the lungs **e. <u>Diaphragm</u>** 1. Describe the component parts of the diaphragm and state its functions 2. Describe the nerve supply and blood supply of the diaphragm 3. State and identify structures passing through the diaphragm including the vertebral levels 4. Use the knowledge of Anatomy in examining the respiratory system 5. State and describe the common clinical problems of the thoracic cavity 6. Clinical correlations of diaphragm related to respiration **f. <u>Development</u>** **1.** Development of the respiratory system and associated developmental abnormalities **2.** Describe the development of the diaphragm including its congenital abnormalities **g. <u>Cross sectional Anatomy</u>**	2hr 1 hr 3 hr 1 hr 1 hr 1 hr	PD (histology) Lecture (histology) Dissections Lecture Lecture Lecture	Anatomy Anatomy Anatomy Anatomy Anatomy Anatomy
2008- 1/1/SBM-2/2				
Mechanics of breathing	1. Recognize that airflow into or out of the lungs depends on the difference between atmospheric pressure, alveolar pressure and airway resistance 2. Recognize that flow is proportional to the pressure difference between two points and inversely proportional to the resistance 3. Recognize that both lungs and thoracic walls are elastic and are capable of recoil	3hrs	Lecture	Physiology

	4. Recognize that the elastic recoil of the lungs and the chest wall is responsible for creating a negative intrapleural pressure. 5. Describe the events during normal expiration at rest and during forced expiration. 6. Define the terms alveolar pressure, intrapleural pressure and transpulmonary pressure and state their magnitude at the end of a quiet respiration 7. Define and explain the following terms: anatomic dead space, physiologic dead space, wasted (dead space) ventilation, total minute ventilation and alveolar minute ventilation. 8. Explain the term lung compliance and describe the factors affecting compliance such as elasticity of lung tissue and surface tension of alveoli 9. Draw a normal pulmonary pressure-volume (compliance) curve. Explain the cause and significance of the hysteresis in the curves. 10. Describe the role of surfactant in maintaining alveolar surface tension. 11. Define surface tension and describe how it applies to lung mechanics, including the effects of alveolar size and the role of surfactants. 12. Describe the principal components of pulmonary surfactant and explain the roles of each. 13. Be aware of the respiratory distress syndrome of the newborn and the rationale of its management. 14. Explain the term airway resistance and list the factors controlling airway resistance 15. Describe the effects of airway diameter and turbulent flow on airway resistance. 16. Understand the following terms; Dynamic lung compliance, static lung compliance, closing volume and closing capacity. 17. Describe how airway resistance alters dynamic lung compliance. 18. Define the factors that determine total lung capacity, functional residual capacity, and residual volume. Describe the mechanisms responsible for the changes in those volumes (which include closing volume and closing capacity) that occur in patients with emphysema and pulmonary fibrosis. 19. Define “dependent lung” and discuss the mechanism underlying distribution of regional ventilation in various body positions.	1 hr	Lecture	Biochemistry (Obj. 11, 12&13)

2008- 1/1/SBM-2/3				
Assessment of lung function	1. Describe the basis of measuring lung volumes using spirometry. 2. Define and explain the terms; tidal volume, expiratory reserve volume, inspiratory reserve volume, vital capacity, functional residual capacity, total lung capacity, residual volume. 3. Observe how spirometry is performed. 4. Obtain readings of peak flow rate with the peak flow meter. 5. Identify normograms and determine lung volumes and capacities using normograms. 6. Draw a spirogram resulting from a maximal expiratory effort. Label the forced vital capacity (FVC), timed forced expiratory volumes (FEV), and the maximal expiratory flow rate between 25-75% of FVC ($FEF_{25-75\%}$). 7. Differentiate between the two broad categories of restrictive and obstructive lung disease, including the spirometric abnormalities associated with each category.	3 hrs 4 hrs	Practical CCR	Physiology CCR group
2008- 1/1/SBM-2/4				
Non-respiratory functions of the respiratory system	1. describe the defense mechanisms in the lungs and upper airways including mucociliary clearance, cough, sneezing and alveolar macrophages 2. describe the role of the upper airways in warming and humidifying inspired air 3. describe other functions of the respiratory system such as metabolic, olfactory, phonation.	1 hr	Lecture	Physiology
2008- 1/1/SBM-2/5				
Gas exchange, diffusion of gases, and perfusion in the lung	1. Explain the term RQ (respiratory quotient). 2. Define partial pressure and fractional concentration as they apply to gases in air. List the normal fractional concentrations and sea level partial pressures for O_2, CO_2, and N_2. 3. State the alveolar and blood gas pressures and discuss the factors that determine alveolar gas pressure 4. Explain O_2 and CO_2 composition of alveolar gases 5. Describe the process of gas exchange at the lungs in terms of the respiratory membrane, factors affecting gas exchange, role of diffusion and diffusing capacity	3hrs 2hrs	Lecture SGD	Physiology Physiology

	6. Describe the functional anatomy, pulmonary vascular pressures and capillary dynamics of the pulmonary circulation 7. Describe the regional differences in pulmonary blood flow in an upright person. Define zones I, II, and III in the lung, with respect to pulmonary vascular pressure and alveolar pressure. 8. Describe the consequence of hypoxic pulmonary vasoconstriction on the distribution of pulmonary blood flow. 9. Explain the term ventilation-perfusion inequality. 10. Explain V/Q mismatch. 11. Identify the average V/Q ratio in a normal lung. Explain how V/Q is affected by the vertical distribution of ventilation and perfusion in the healthy lung. 12. Explain the oxygen cascade			
2008- 1/1/SBM-2/6				
Transport of respiratory gases	1. Explain how O_2 is transported in blood 2. Explain the relationship between PO_2 and dissolved plasma O_2 content (Henry's Law). 3. Draw the O_2 dissociation curve and explain why it has a sigmoid shape 4. List the factors affecting the oxygen dissociation curve and state how each of them affects the affinity of Hb for O_2 5. Explain how CO_2 is transported in blood 6. Describe the importance of the chloride shift in the transport of CO_2 by the blood. 7. Draw the carbon dioxide dissociation curves for oxy- and deoxy-hemoglobin. 8. Discuss oxygen dissociation curve in anaemia and abnormal Hb 9. Explain Bohr and Haldane effects 10. Explain oxygen carrying capacity and oxygen delivery to tissues	2hrs 2hr 2 hrs	Lecture PD Lecture (Obj. 8-10)	Biochemistry Biochemistry Physiology
2008- 1/1/SBM-2/7				
Regulation of respiration	1. Describe the regions in the CNS that play important roles in the generation and control of cyclic breathing 2. explain the factors affecting rate and rhythm of respiration 3. Give three examples of reflexes involving pulmonary receptors that influence breathing frequency and tidal volume. Describe the receptors and neural pathways involved. 4. Recall the role of peripheral and central chemoreceptors in the control of ventilation. Identify the relative importance of each in	3 hrs	Lecture	Physiology

	sensing alterations in blood gases. 5. Explain the role of respiration in acid-base balance 6. Describe how changes in arterial PO_2 and PCO_2 alter alveolar ventilation, including the synergistic effects when PO_2 and PCO_2 both change. 7. Describe the respiratory drive in a COPD patient, and predict the change in respiratory drive when oxygen is given to a COPD patient.			
2008- 1/1/SBM-2/8				
Respiration in special circumstances	1. <u>Exercise</u> a. Contrast the normal distribution of cardiac output with the distribution of cardiac output during aerobic (sustained) exercise and anaerobic (brief maximal burst) exercise. Include the local regulation of blood flow and the role of capillary reserve in altering skeletal muscle blood flow. b. Describe how pulmonary vascular resistance changes with alterations in cardiac output or pulmonary arterial pressure. Explain in terms of distention and recruitment of pulmonary vessels. c. Define VO_{2MAX} and identify situations in which it is limited by cardiac output and by pulmonary gas exchange. d. Describe the significance of the feed forward control of ventilation (central command) during exercise, and the effects of exercise on arterial and mixed venous PCO_2, PO_2, and pH. \ e. Define the effects of training on the heart and coronary circulation and how these changes contribute to an increase in VO_{2MAX}. f. Explain how each of the following can alter exercise performance: muscle fatigue, VO_{2MAX}, anaerobic threshold, gender, and age. 2. <u>Acclimatization to high altitude</u> - Explain the oxygen cascade - Recall that PO_2 in inspired air falls progressively with increase in altitude - Sate the altitude at which acute effects of hypoxia are felt. - Describe the acute effects of hypoxia - Explain the causation and the effects of the following in acclimatization to high altitude; o increased pulmonary ventilation o increased RBC count and Hb	3 hrs 2hrs 2hrs 2hr	Lecture SGD PD Lecture	Physiology Physiology Physiology Physiology

	o raised diffusing capacity o increased tissue vascularity o increased ability of cells to utilize oxygen - State the anthropometric and physiological changes that are seen in natural acclimatization (adaptation) of those individuals native to high altitudes. 3. Deep-sea diving / Air / Space travel a. Describe the effects of hyperbaric pressure/ N_2 narcosis b. Describe the physiological basis of shallow water blackout during a breath-hold dive	1 hr	Lecture	Physiology
2008- 1/1/CLM-2/1				
Imaging of respiratory organs of the thorax	1. correlate gross anatomy with biplanear and cross-sectional imaging 2.Explain the principles of lung perfusion imaging	1 hr 1hr	Lecture demonstration Lecture demonstration	Radiology NMU
2008- 1/1/CLM-2/2				
Clinical examination of the respiratory system	Perform a physical examination of the respiratory system	3 hrs	Practical Demonstration	Physiology
2008- 1/1/CLM-2/3				
Basic Life Support	Understand the importance of the Basic Life Support (BLS). Demonstrate how to perform BLS.	1 hr 2 hrs	Lecture PD	Anaesthesia

Respiration & Gas Exchange module (Year 1 Semester 1)
Module Summary

	Lectures (hrs)	PD (hrs)	Dissection (hrs)	CCR (hrs)	SGD (hrs)	Total (hrs)
Anatomy	6	5	15			26
Physiology	18	8		4	4	34
Biochemistry	3	3			2	8
Radiology	1					1
NMU	1					1
Anaesthesia	1	2				3

Total	**30**	**18**	**15**	**4**	**6**	**73**

Names and the departments of the teachers involved in the teaching programme:

Dept. of Anatomy
Prof. M. Chandrasekera
Dr Sanjaya Adikari
Dr. Ajith Sominanda
Dr. Himani Amarathunge
Dr. Deepthi Nanayakkara
Dr PCA Ratnatunge

Dept. of Biochemistry
Prof. R. Sivakanesan
Dr. P.H.P. Fernando
Dr. HKI Perera
Dr. S.B.P. Athauda
Dr. Shirani Ranasinghe

Dept. of Anaesthsiology
Dr. Vasanthy Pinto

Head/NMU

Dept. of Physiology
Dr. Jayantha Rajaratne
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Dr. Shamila Rajaratne
Dr. Anoja Ariyasinghe
Dr. P Dahanayake

Dept. of Radiology
Dr. Badra Hewavitharana

Examination Format

Module	Credits	Total duration of examination	MCQ	SAQ	OSPE
Respiration	3	3 ½	1	1 ½	1