GE Learning Outcomes 2013

### THEME: Cellular & Molecular Science

**Module Leaders:** Dr Charlotte Bevan

### Learning Outcomes

Protein Structure

*Learning Objectives:*

* Outline the reaction by which amino acids are joined together.
* Appreciate the different types of bond that combine to stabilise a particular protein conformation.
* Sketch a trimeric peptide, illustrating the amino -terminus, carboxyl terminus and side chains.
* Distinguish between a α-helix and a ß-pleated sheet and appreciate the bonds that stabilise their formation.
* Understand the concepts of primary structure, secondary structure, tertiary structure & quaternary structure with respect to proteins.
* Outline how warfarin works with reference to the post translational modification of glutamate.

Nucleic Acids and Chromosomes

*Learning Objectives:*

* Draw the structure of a nucleotide labelling the sugar, base and phosphates and explain the difference between a nucleotide and a nucleoside.
* List the bases found in DNA and RNA and indicate which ones are purines and which ones are pyrimidines.
* Describe a single DNA chain and explain the difference between the 5’ and 3’ ends.
* Draw the structure of the double-stranded helix of DNA (not atomic structure) showing base-pairing, the major and minor grooves, and the directionality of the chains.
* Describe melting and re-annealing of complementary strands and what is meant by Watson-Crick base-pairing.
* Compare the genomes of *E.coli* and *Homo Sapiens.*
* Draw a diagram illustrating the packaging of DNA into nucleosomes and relate this to chromosome structure.
* Describe the human karyotype.

Nucleic Acids and Gene Expression

DNA replication, the cell cycle and mitosis

*Learning Objectives:*

* Explain semi-conservative replication.
* Describe the reaction catalysed by DNA polymerases.
* Describe how nucleoside analogs can be used as drugs.
* Describe the functions of the components of the replication complex including the terms template, primer, leading strand, lagging strand, Okasaki fragment and replication fork.
* Describe how accuracy is maintained by proof-reading and the use of RNA primers.
* Draw a diagram showing replication of the *E.coli* chromosome.
* Describe the replication of mammalian chromosomes.
* Describe the different phases of the cell cycle.
* Draw a diagram showing how the chromosomes segregate at metaphase.

Nucleic Acids and Gene Expression

Gene Organisation & Transcription Part 1 - Gene Transcription

*Learning Objectives:*

* Describe the basic differences between DNA and RNA
* Describe what is meant by “transcription”
* List the major functional classes of RNA and the classes of RNA polymerases involved in synthesising each of these.
* Describe what is meant by a “gene promoter”
* Describe what is meant by a “transcription factor”
* Describe, with the aid of diagrams, the processes involved in transcribing a eukaryotic gene.

Nucleic Acids and Gene Expression

Gene Organisation & Transcription Part 2 - mRNA Processing

*Learning Objectives*

* Describe, with the aid of diagrams, the events that take place in pre- mRNA processing
* Define what is meant by a “splice donor site”
* Define what is meant by a “splice acceptor site”
* Describe the “lariat” intermediate in mRNA splicing
* Define the function of the “Spliceosome”
* Describe the addition of a “cap” and “poly A tail” to pre-messenger (hn-) RNA.
* With examples, describe how mutations in splice sites feature in human disease.

Nucleic Acids and Gene Expression:

**Protein translation & post-translational modification**

*Learning Objectives*

* Outline the mechanisms by which ribosomes can translate a mRNA sequence into a protein sequence.
* Describe the role of aminoacyl tRNAs in ensuring the fidelity of the genetic code.
* State how a ribosome recognises the start and end of a sequence to be translated.
* Explain why some antibiotics inhibit protein synthesis in prokaryotes but not eukaryotes.
* Identify the features of a newly-synthesised protein that are required for it to enter the secretory pathway.
* Give examples of the ways in which newly-synthesised proteins can be post-translationally modified.

Nucleic Acids and Gene Expression

Analysis of Nucleic acids

*Learning Objectives:*

* Explain the term hybridisation, used for binding of a probe to a nucleic acid.
* Explain the concept of stringency of hybridisation, and the factors that contribute to stringency.
* Explain how the polymerase chain reaction (PCR) is used to amplify small amounts of DNA for subsequent analysis.
* Describe in general terms the way in which PCR primers would be selected to amplify a given DNA sequence.
* Describe the reactions carried out by restriction enzymes (restriction endonucleases) and explain their usefulness in analysis of DNA.

***Introduction to Cells and the Cell Membrane –Self-directed learning***

* Outline the main components of prokaryotic and eukaryotic cells.
* Understand what constitutes a cell, and the scale of cells and molecules
* Demonstrate the following on a suitable transmission electron micrograph: nucleus, nucleolus, nuclear envelope, mitochondrion, rough/smooth endoplasmatic reticulum, ribosomes, Golgi apparatus, secretory granule, plasma membrane, cytoskeletal components
* Identify the essential characteristics of prokaryotic and eukaryotic cells
* Explain the relationship of individual cells to the organization of the whole body
* Explain the formation of phospholipid bilayers in an aqueous environment

• Draw the structure of phosphatidylcholine and identify the component parts

* Describe the permeability properties of a phospholipid bilayer with respect to macromolecules, ions, water, and organic compounds (including drugs)
* distinguish simple diffusion, facilitated diffusion and active transport of ions and molecules across cell membranes
* Categorise the functions of membrane proteins
* Explain the movement of Na+ and K+ ions across the cell membrane against a concentration gradient and the consequences of failure of such a movement
* Explain how the entry of glucose and amino acids into the cell against a concentration gradient is coupled to ATP dependent Na+ transport
* Explain how external chemical signals can be sensed at the interior of a cell

***Introduction to Blood and infectious agents –Jasmina Saric***

* List the main functions and components of the blood
* Outline the differences in blood composition between male and female
* Describe the essential features of the erythrocyte and list its major functions
* Define anemia and list the major causes
* Describe the major requirements, nutritional and otherwise, of normal erythropoiesis
* List the major differences between the main hematopoietic cell populations of normal blood
* Explain simply the major functions of leukocytes and platelets
* Describe the features of the main types of infectious agents.
* Describe the constituents, properties and functions of cell membranes.
* Describe the constituents of blood and their function.
* Classify the main types of diseases and their effect on cells and tissues.

***Cellular Organisation of Tissues- self directed learning***

* Describe the features of epithelial cells and of the extracellular matrix.
* Illustrate how epithelial cells have specialised functions, and describe their different patterns of cell division.
* Describe the structure and role of the extracellular matrix, and the structure and role of collagen in intracellular and extracellular structures.
* Describe the molecules of the extracellular matrix and the regulation of collagen assembly.
* Describe the composition of the main body fluids and the mechanisms which control their volume.
* Describe the mechanisms of signalling along, and in between, excitable cells as well as the factors which control the amount of force exerted by a muscle.
* Explain how signals are transmitted between cells, and between the cell periphery and the nucleus.

***Cell behaviour***

**Cell behaviour I**

* Describe the roles of growth factors, cell contacts and tissue boundaries in the control of division of normal and transformed cells.
* Describe the mechanisms of cell locomotion, with reference to the three filament systems that define the cytoskeleton.
* Understand the role of metastasis in the development of cancer.
* Describe the various types of molecular motors and polymerisation engines that are responsible for biological movement at the cellular level.
* Understand the molecular basis of muscle contraction.
* Describe the mechanisms that control cell locomotion.
* Describe the mechanisms that control cytoskeletal processes occurring during cell locomotion, with reference to phosphorylation, secondary messengers and G-proteins.

**Cell behaviour II**

* Highlight the major differences between the three main cytoskeletal proteins
* Understand the functional roles of microtubules and describe the drugs that target these structures
* Understand how intermediate filaments are assembled and describe their classification system
* Describe the functional roles of intermediate filaments with relation to their involvement in disease
* Describe the structure and function of actin and associated proteins

**Cell behaviour II**

* Be able to name all the major structural features of a sarcomere
* Understand the process of excitation-contraction coupling in muscle
* Understand the ‘sliding filament’ theory of muscle contraction

*METABOLISM 1:  ATP Production I - Glycolysis and the TCA Cycle*

• Sketch a cartoon of the three stages of cellular metabolism that convert food to waste products in higher organisms, illustrating the cellular location of each stage.

•Explain how ATP acts as a carrier of free energy and is used to couple energetically unfavourable reactions.

• Illustrate the role of the coenzyme NAD in the reaction catalysed by dehydrogenases.

• Outline the metabolism of glucose by the process of glycolysis, citing the key reactions that consume ATP and generate ATP and the possible fates of pyruvate.

• Describe the reactions catalysed by lactate dehydrogenase and creatine kinase.

• Outline the oxidative decarboxylation reaction catalysed by pyruvate dehydrogenase.

• Describe the Krebs or TCA (tricarboxylic acid cycle) with particular reference to the steps involved in the oxidation of acetyl Co-A and the formation of NADH and FADH2 and the cellular location of these reactions.

*METABOLISM 2: ATP production II - Oxidative phosphorylation*

• Describe the process of transamination and how it may generate glycolysis/TCA intermediates from amino acids.

• Outline the chemiosmotic theory.

• Describe the electron transport chain in mitochondria with reference to the functions of coenzyme Q (ubiquinone) and cytochrome c.

• Describe how ATP synthase is able to generate and utilise ATP respectively, with reference to its structure.

• Explain why carbon monoxide, cyanide, malonate and oligomycin are poisonous in terms of their effects on specific components of the electron transport chain.

• Outline the glycerol phosphate shuttle and the malate-aspartate shuttle, in particular stating why these mechanisms are required.

*METABOLISM 3: Lipid and Cholesterol Metabolism*

•Appreciate the chemical composition of unsaturated and saturated fatty acids.

•Describe the reactions by which the fatty acid palmitate is metabolised to give acetyl-CoA.

•Give an overview of the reactions by which fatty acids are synthesized from acetyl-CoA, contrast the pathways for synthesis with those of fatty acid metabolism.

•Outline the synthesis of cholesterol from acetyl CoA.

•Outline the synthesis of bile acids and steroid hormones from cholesterol.

•Suggest why NADPH and not NADH is used in reductive biosynthesis.

•Describe the mechanism of transport of cholesterol around the body and its uptake into cells.

•Draw a diagram of low density lipoprotein (LDL) particle and its receptor (LDLR).

•Explain how mutations of the LDLR give rise to familial hypercholesterolaemia.

• Give examples of pharmacological agents that may be used to control cholesterol metabolism.

*Lectures 1 & 2. The Cell Cycle and its Regulation*

* Describe the cell cycle in terms of the named phases (G0, G1, G2, S, M) and explain what these mean in terms of protein and DNA synthesis and chromosome dynamics.
* Identify (or sketch or describe) the named stages of mitosis.
* Describe how the cell cycle is regulated by interactions between cyclins, cyclin- dependent kinases, inhibitor proteins, proteosomes, other kinases and phosphatases.
* Introduce the principle of the molecular timing process which regulates the cell cycle through oscillating amounts or activities of cyclins and their kinases
* Explain the importance of checkpoints in controlling progression through the cell cycle, and give examples of external factors, which provide signals allowing cells to pass these checkpoints and enter cell division.
* Describe the way the cell cycle allows decision making about whether a cell divides, differentiates or undergoes programmed cell death (apoptosis).
* Explain in molecular terms the mechanism of action of the retinoblastoma (Rb) susceptibility tumour suppressor gene product.
* Describe the concept of a signaling pathway with examples of the kind of molecules involved, especially kinase cascades.
* Describe how signaling pathways respond to physiological signals and control cell proliferation though interactions with the cell cycle machinery
* Identify key proteins involved in each of the above processes and give examples of diagnostic/therapeutic benefits resulting form such knowledge

*Lecture 3. DNA Damage and Repair*

* Describe the ways in which DNA can be damaged by endogenous and environmental factors.
* Summarise the main natural DNA repair mechanisms: BER, NER, MMR and DSB repair (NHEJ & HR)
* Describe the DNA damage response pathways and key proteins involved
* Outline some inherited disease that result from mutations in genes involved in DNA repair or the DDR
* Identify key proteins involved in each of the above processes and give examples of diagnostic/therapeutic benefits resulting form such knowledge

*Lecture 4. Oncogenes and Tumour Suppressors .*

* Define the terms protooncogene, oncogene and tumour suppressor gene.
* Explain how a protooncogene can be activated to an oncogene.
* Explain with an example how conversion of a protooncogene to an oncogene can lead to disruption of tightly controlled pathways in the cell.
* Describe with an example how rare heritable cancers have led to an understanding of the type of cancer-causing gene called a tumour suppressor.
* Summarise the role of the tumour suppressor gene p53 in cellular decision making.
* Using colon cancer as an example, describe the way in which successive gene mutations are thought to lead to clinical cancer.

The following learning objectives relate to the lectures given by Prof Gerry Thomas, to whom any queries should be directed in the first instance.

**Cellular Pathology**

* Understand the nomenclature that differentiates malignant and benign cancers and their differentiation and development stage.
* Describe the microscopical features of carcinomas.
* Describe the mechanisms of invasion and metastasis and the factors that affect sites of metastases.
* Explain the terms 'grading' and 'staging', and how this relates to clinical outcome
* Understand the role of molecular pathology in treatment tailoring

**Breast Cancer**

* Understand the types of breast cancer and how it is treated
* The differences between hormone and chemotherapy
* The mechanisms by which oestrogen receptor signalling can be disrupted
* How biology affects prognosis

**Colon cancer**

* Understand the types of colon cancer and how it is treated
* The relationship between diet and colon cancer
* Grading of colon cancer
* Clinical presentation and factors affecting prognosis
* Treatment of colon cancer (including effect of mutations in key oncogenes e.g. BRAF, KiRas)

**Skin Cancer**

* Understand the different types of skin cancer and their causes and prognosis
* Understand risk factors for melanoma
* Understand pathological grading and staging and how this affects treatment and outcome
* Understand how and why melanoma patients may be stratified for treatment in the future

**Leukaemia and Lymphoma**

* Understand the differences between lymphoma, myeloma and leukaemia
* Understand the diagnosis and treatment of the above
* Understand the difference between acute and chronic leukaemia
* Understand how targeted therapies have made a difference to treatment of leukemia

### Genetics

**Theme Leader:** Dr Claire Shovlin

###### GENETICS 1: Tools and mutations, pedigrees and patterns

###### **Claire Shovlin**

* Understand the contribution of genetics to human disease
* Understand the potential molecular effects of changing DNA sequence

 - for coding DNA: single nucleotide: missense; stop codons;

 insertions & deletions; in frame; out of frame;

- for non coding DNA: very basic principles

* 2) Define polymorphisms and mutations
* 3) Define genetic markers, and explain how these are used to follow inheritance
* 4) Understand what is meant by loci, alleles, and phase
* Have the tools to describe and record inheritance
 - be able to draw a multigeneration family tree
* Recognise, describe and explain recessive, dominant and X-linked inheritance; give an example of each, and discuss broad treatment implications
* Understand non Mendelian segregation patterns and causes

###### GENETICS 2 (AND WORKSHEET 1): CALCULATIONS AND COMMUNICATION

###### **Claire Shovlin**

* *CONFIRM YOUR ABILITY TO PERFORM SIMPLE CALCULATIONS BASED ON MENDELIAN PRINCIPLES.*  If by the end of the course you do cannot produce the Worksheet 1 answers by yourself, then this topic needs further study.
* Appreciate issues regarding communication of genetics principles

- the potential impact of the information you impart;

- ways that can improve your ability to communicate information.

##### GENETICS 3: The Genetic Basis of Disease

##### ***Andrew Walley***

* Explain with examples the concept of aneuploidy
* Draw a diagram showing possible meiotic products from a balanced translocation
* Describe how 3 different chromosome aberrations lead to Down syndrome
* Explain why sex determination is not solely based on sex chromosome karyotype
* Explain the classification of congenital defects. Explain how non-genetic factors lead to congenital abnormalities
* Give two examples of inborn errors of metabolism currently included in UK national neonatal screening programmes, including clinical features and therapeutic management of each condition

**GENETICS 4: Complex genetic diseases**

*tbc*

* Explain the concept of genetic susceptibility to common disease.
* Explain how we can estimate the heritability of a common complex disease
* Describe the susceptibility/threshold model
* Discuss genetic heterogeneity in complex disease
* Discuss one particular disease as an example of complex inheritance
* Describe how genome-wide SNP association studies are designed and their contribution to our understanding of common diseases with examples
* Discuss the implications of genetics for clinical management of common disease

**GENETICS 5: Cancer in families and individuals**

*Alistair Reid*

1) Explain the difference between somatic and germline mutations

 2) Understand why genetic changes cause cancer and describe the 2 main classes of cancer gene

 3) Understand the contribution of chromosome rearrangements to the formation of gene fusions and their contribution to oncogenesis.

 4) Discuss how inherited mutations in BRCA1 and BRCA2 genes influence risk of breast and ovarian cancer

 5) Outline how defects in cell division or DNA repair influence risk of colorectal cancer

 6) Explain, using an example, how chromosome translocations are used to quantify residual disease in some leukaemias.

 7) Explain with examples what is meant by a “pharmacogenomic marker”

**GENETICS 7: The future of genomic medicine**

*Jess Buxton*

* Describe the basic principles of and ethical considerations in pre-implantation genetic testing
* Explain how next generation sequencing is being used to determine the molecular basis of monogenic diseases
* Compare and contrast examples of direct-to-consumer genetic testing services and discuss their relative merits and problems
* Give examples of how advances in genomic medicine may lead to personalised medicine

**GENETICS 8: Final thoughts- the mainstreaming of genetics**

*Claire Shovlin*

In this session we will discuss the emerging requirements for genetics and genomics to be incorporated into all medical specialities, with further examples of the knowledge base required.

You will need to be able to give examples of where a genetic disease:

* displays more than one inheritance pattern;
* is caused by mutations in more than one gene;
* is caused by mutations in the same gene as a different disease
* phenotype is altered by a mutation in another gene

We will ensure that you can apply in the setting of prenatal screening[[1]](#footnote-1), giving examples of

* non-invasive tests ( maternal serum screening and ultrasound vs invasive tests – amniocentesis and chorionic villus sampling)
* Types of anlalyses available (karyotype , array CGH and FISH for detection of chromosomal abnormalities
* PCR for mutation detection with examples

We will also discuss the second worksheet , and other issues arising from the course.**Self-directed learning objectives**

**GENETICS WORKSHEET 1 (Week 1)**

*You will gain more from this exercise if you perform the calculations yourself before the answers are discussed in class.*

* Demonstrate an understanding of Mendelian segregation, by being able to perform simple genetic risk calculations.

**GENETICS WORKSHEET 2 (Week 2-5)**

*You will gain more from this if you do these exercises yourself, before the discussions scheduled for the last day of the course.*

* Be aware of online resources for information on genetic disease, including OMIM, Genecards, the National Genetics Education Development Centre and the NHS library resources on genetic conditions;
* Understand the basic principles of meiosis and non-disjunction;
* Understand the basic principles of karyotype analysis and the clinical features of trisomy 21;
* Be able to give named examples of genetic disorders with different modes of inheritance;
* Be able to give two examples where different types of mutation in the same gene cause different monogenic disorders;
* Understand the basic principles of DNA purification, PCR and agarose gel electrophoresis and how these might be used to investigate human diseases.

### Haematology

**Theme Leader:** Dr Amin Rahemtulla

#### Learning Outcomes

*Theme 1 Haemopoietic and blood cells, basic laboratory tests and terminology*

The student should be able to:

* Explain the origin, function and approximate intravascular life span of red cells, neutrophils, lymphocytes and platelets
* Explain the function of red cells, neutrophils, monocytes, eosinophils and lymphocytes
* List the main physiological factors that influence the rate of red cell production
* State the approximate intravascular life span of red cells, neutrophils and platelets
* Explain the possible mechanisms of anaemia and polycythaemia
* Recognize the terms commonly used in describing abnormalities in blood counts and films and explain what they mean
* Explain how to assess whether the result of a laboratory test is normal of abnormal including an explanation of the concept of a ‘normal’ or ‘reference’ range
* State the approximate normal ranges for adult men and women for haemoglobin, white cell count, mean cell volume and platelet count and explain how age, gender and ethnic origin can influence a reference range
* Explain the term anaemia
* Describe the possible mechanisms of anaemia
* Describe the classification of anaemia on the basis of red cell size
* List the common causes of microcytic, normocytic and macrocytic anaemia
* List causes of haemolytic anaemia and describe how you would recognise a haemolytic anaemia
* Explain the possible mechanisms underlying polycythaemia

*Theme 2 Anaemia (iron, vitamin B12, folic acid, anaemia of chronic disease, anaemia of renal failure)*

The student should be able to:

* Describe the role of iron in erythropoiesis, dietary sources of iron, absorption of iron, causes of iron deficiency, clinical and haematological features of iron deficiency and the diagnosis and management of iron deficiency
* Describe the clinical and haematological features of anaemia of chronic disease and explain how this is distinguished from iron deficiency
* Describe the role of vitamin B12 and folic acid in haemopoiesis, dietary sources and absorption of these vitamins, causes of deficiency, clinical and haematological features of vitamin B12 and folic acid deficiency and the diagnosis, further investigation and management of these deficiencies
* Explain that
* Synthesis of DNA requires both vitamin B12 and folate
* Integrity of the nervous system requires vitamin B12
* Deficiency of either causes anaemia, which is both macrocytic and megaloblastic (and explain what these words mean)
* Explain why patients with renal failure are anaemic

*Theme 3 Anaemia (variant haemoglobins, thalassaemia and haemolytic anaemia)*

The student should be able to:

* Describe the structure and function of the haemoglobin molecule and list the normal haemoglobins in the fetal, neonatal and adult periods
* Describe the genes controlling haemoglobin synthesis and explain how genetic defects lead to α and β-thalassaemias
* Describe briefly the clinical and haematological features of β-thalassaemia trait, how it is diagnosed and why this is important
* Describe the haematological features of β thalassaemia trait, how it is diagnosed and why this is important.
* Describe how β-thalassaemia trait can be differentiated from iron deficiency anaemia and the anaemia of chronic disease
* List mechanisms of haemolytic anaemia and explain how defects of the red cell membrane, red cell enzymes and haemoglobin can lead to haemolysis
* Describe how a haemolytic anaemia could be recognized

*Theme 4* **Haemostasis** **and abnormalities of haemostasis**

The student should be able to:

* Describe the normal haemostatic mechanisms including the interactions of vessel wall, platelets and clotting factors
* Describe and distinguish the clinical features of bleeding due to thrombocytopenia and coagulation disorders, respectively
* Describe the use of laboratory tests to assess haemostasis
* Describe the principles of management of disorders of haemostasis

*Theme 5 Blood transfusion*

The student should be able to:

* Describe the major significant blood groups and their importance clinically
* Describe the screening of blood donors undertaken and explain why this is done
* Describe the various blood components used and the potential side effects of blood transfusion

*Theme 6 White cell and leukaemia*

* The student should be able to:
* Explain, in a patient with leucocytosis or leucopenia, the importance of the differential count and peripheral blood morphology in planning further investigation
* List the most common causes of an increased or a decreased neutrophil, eosinophil and lymphocyte count
* Explain how, in a patient with lymphocytosis, a reactive change (e.g. to infection) is distinguished from a primary lymphoproliferative disorder (such as chronic lymphocytic leukaemia)

*Theme 7 Sickle cell anaemia*

* Describe the inheritance of clinical and haematological features of sickle cell anaemia (SS)
* Outline principles of management
* Explain the inheritance, clinical significance and diagnosis of sickle cell trait

### THEME: Anatomy

**Module Leaders:** Prof Ceri Davies

### Learning Outcomes

#### Anatomy of the Thorax

Session 1 – Concepts in Anatomy/Topography of the Thorax

***Note that these objectives are absolutely fundamental basic knowledge***

1. Name and describe the contents of the space between adjacent ribs
2. Identify a rib and be able to determine which part of the rib lies posteriorly and which anteriorly.
3. Name the structures with which a rib articulates.
4. Identify the clavicle and demonstrate how it is positioned in the body.
5. Identify the scapula and demonstrate how it is positioned in the body.
6. Describe the pectoralis muscles and their attachments and explain their actions.
7. Identify a thoracic vertebra.
8. Name the different parts of a thoracic vertebra.
9. Explain how ribs are related to the thoracic vertebrae.
10. Explain how vertebrae articulate with each other and how they support loads and absorb jolts.

Session 2 – Chest wall, lungs, pleura

**Learning Objectives**

1. *Define* the pleura.
2. *Name* the layers of the pleura.
3. *Define* the extent of the lungs.
4. *Define* the extent of the pleura.
5. *State* how the right and left lungs are normally distinguishable.
6. *Identify* the structures present at the hilum of the lung.
7. *Explain* the term *pulmonary circulation*
8. *Demonstrate the landmarks of the chest wall on a living subject.*
9. *Demonstrate* the positions of the pleural cavities, lungs and lobes of the lungs in the living chest.
10. *Demonstrate* the position of the fissures of the lungs in the living chest.[
11. *Describe and sketch* the lungs, using correctly the following terms: apex, costal surface, mediastinal surface, diaphragmatic surface, upper, middle and lower lobes, oblique and horizontal fissures, hilum of lung.
12. *Explain* the structural basis for breathing, including the differences between light, deep and forced breathing.
13. *Explain* the rationale for the insertion of chest drains in the pleural cavity.

Session 3 - Mediastinum

**Learning Objectives**

1. *Define* the boundaries and contents of the superior mediastinum and the anterior, middle and posterior parts of the inferior mediastinum.
2. *Describe* the position and relations of the aortic arch and descending aorta.
3. *Identify* the origin of the brachiocephalic artery, the subclavian arteries and the carotid system of arteries.
4. *Explain* how blood leaving the heart reaches (a) head and neck, (b) lungs, (c) thoracic and abdominal cavities.
5. *Identify* the superior vena cava and the azygos vein
6. *Explain* how blood returns from the head and neck to the heart.
7. *Explain* the courses and relations within the chest of the phrenic and vagus nerves, the oesophagus and thoracic duct
8. *Use* chest wall landmarks to define the cardiac outline.
9. *Locate* the apex beat.
10. *Identify* the major structures of the mediastinum in radiological images

Session 4 – The heart and coronary circulation

**Learning Objectives**

* *Demonstrate* the four chambers of the heart.
* *Name* the vessels that enter or leave each of the chambers of the heart.
* *Name* the four valves of the heart and indicate where they are situated
* *Describe* the commonest patterns of distribution of the coronary arteries and *explain* the function and importance of these vessels.
* *Explain* the effects of coronary insufficiency and obstruction, including the pathways and localisation of pain associated with these conditions.
* *Describe* the organisation and relationships of the pericardium.
* Using conventional X-ray (CXR), CT and MR images *demonstrate* the landmarks of the heart.
* *Relate* appearances seen in CT and MR sections of the chest to those in the living or dissected body; *recognise* the approximate vertebral level of any chest CT image.
* *Use chest landmarks to define the cardiac outline and great vessels in a living subject.*
* *Locate the apex beat.*
* *Demonstrate the position of the 4 heart valves on a living subject, locate suitable sites for auscultation of each valve and demonstrate correct stethoscope technique.*
* *Outline* the electrical and mechanical cycles of the heart and *relate* these to heart sounds and to features of the ECG trace.
* *Explain* the pathways by which the heart, lungs and the chest wall receive their motor and sensory nerve supplies

Session 5 – The breast, lymphatic drainage and nerves of thorax

**Learning Objectives**

1. Describe the structure of the breast and its relations.
2. Summarise the main functions and anatomical organisation of the lymphatic system.
3. *Describe* the lymphatic and venous drainage of the breast and *relate* these to the pathways of metastasis of breast cancer.
4. *Explain the principles underlying examination of the breast of a living subject.*
5. Describe the lymphatic drainage of the chest viscera (particularly the lungs and bronchi) and outline the implications of this pattern for the spread of lung cancer.
6. *Define* the roles of breast examination and imaging within the epidemiological context of breast cancer incidence.
7. *Define the peripheral nervous system and describe its component parts*
8. Explain the pathways by which the heart, lungs and chest wall receive their motor and sensory nerve supplies.
9. Explain the effects of coronary insufficiency and obstruction, including the pathways and localization of pain associated with these conditions.

#### Anatomy of the Abdomen, Pelvis and Perineum

Session 1 – Anterior abdominal Wall & Hernias

**Learning Objectives**

1. *Demonstrate* in the living body and on a skeleton where appropriate, the following landmarks of the anterior abdominal wall: costal margin, xiphoid process, umbilicus, transpyloric plane, anterior superior iliac spine, iliac tubercle, pubic tubercle, mid-inguinal point.
2. *Demonstrate* the use of these landmarks to divide the anterior abdominal wall into descriptive regions.
3. *Draw* sketches to outline the arrangement of the external and internal oblique and transverse muscle layers, the rectus abdominis and rectus sheath, the transversalis fascia and the parietal peritoneum
4. *Describe* the rectus sheath and its contents.
5. *Define* the linea alba and the linea semilunaris
6. *Explain* the importance of the distinction between the fatty and membranous layers of the superficial fascia
7. *Define* the sources and distribution of the motor and sensory nerves to the abdominal wall and diaphragm.
8. *Explain* the roles of the abdominal wall muscles in breathing and control of intra-abdominal pressure.
9. *Demonstrate* in the living subject and in dissected material the nature and course of the inguinal canal making correct use of the following terms: superficial and deep inguinal rings, mid-inguinal point, pubic tubercle, testis, testicular vessels, scrotum, spermatic cord, ductus deferens, round ligament of the uterus.
10. *Distinguish* between direct and indirect inguinal hernias.
11. *Distinguish* between acquired and congenital inguinal hernia
12. *Outline* the lymphatic drainage of the anterior abdominal wall

Session 2 – Peritoneal cavity and bowel

**Learning Objectives**

* *Name* the regions of the gut from oesophagus to rectum and summarise their main functions
* *Demonstrate* these gut regions in dissections and *point out* their identifying characteristics
* *Define* parietal and visceral peritoneum and *explain* the functions of the peritoneum and peritoneal cavity
* *Describe* the peritoneal reflections in relation to major parts of the gut and associated organs from the oesophagus to the rectum, with special attention to the attachments and contents of the greater and lesser omenta and the mesentery proper
* *Draw* diagrams to explain the different relationships of the aviscera to to the peritoneum (mesenteries and retroperitoneal positions) and *list* the structures contained within a typical mesentery

*Describe* the boundaries of the lesser sac and of the epiploic foramen (of Winslow)

* *Demarcate* the extent of the peritoneal cavity in a living subject and *indicate* the likely positions of the major regions of the gut
* *Describe* the sources and distribution of arteries to important structures or organs derived from the foregut, midgut and hindgut.
* *Describe* the bones, joints and movements of the lumbar spine, sacrum and pelvis

Session 3 – Liver Biliary Tree & Spleen

**Learning Objectives**

1. *Describe* the important anatomical relations of the liver, gall bladder, and spleen.
2. *Distinguish* between anatomical and functional lobes of the liver.
3. *Demonstrate* the positions of the liver, gall bladder and spleen in a living subject.
4. *Examine* the liver using percussion and palpation.
5. *Demonstrate* on a liver the surfaces, lobes, gall bladder, porta and lesser omentum and their contents, hepatic veins, falciform and coronary ligaments.
6. *Demonstrate* the hepatic ducts, cystic duct and common bile duct in dissections and in contrast imaging and *sketch* the most common arrangement*.*
7. *Demonstrate* the relations and mesenteric attachments of the spleen.
8. *Demonstrate* and *sketch* the relations of the pancreas to the duodenum, great vessels, left kidney and spleen.
9. *Demonstrate and name* the main abdominal lymph nodes and *outline* the main pathways of lymphatic drainage of the major abdominal organs.
10. *Describe and outline* the implications of the lymphatic drainage of the stomach and the pancreas.

Session 4 – Blood supply to gut and nerves of the abdomen

**Learning Objectives**

1. *Demonstrate* and *name* the renal arteries, coeliac axis and superior and inferior mesenteric arteries and their branches in anatomical specimens and in radiographs.
2. *Explain* the significance of the portal circulation.
3. *Identify* the common sites of portal-systemic anastomoses
4. *Describe* the anatomical basis of biliary obstruction and portal hypertension
5. *Describe* the origins and pathways by which autonomic nerves reach the abdomen.
6. *Discriminate* between the distributions and motor functions of the sympathetic and parasympathetic nerves in the abdomen.
7. *Compare* the sensory functions of the sympathetic and parasympathetic nerve supplies in the abdomen.
8. *Outline* the segmental pattern of pain fibre distribution to the abdominal viscera.
9. *Explain* the concept of referred pain and *identify* the most probable sites to which pains of abdominal visceral or diaphragmatic origin are likely to be referred.
10. *Identify* in suitable dissections the sympathetic chains, splanchnic nerves, pre-aortic sympathetic ganglia and the vagus nerves.

Session 5 – The retro-peritoneum

**Learning Objectives**

1. *Define* the term ‘retroperitoneum’
2. *Demonstrate* and *draw* the principal relations of the duodenum, pancreas and kidneys including major vascular relations.
3. *Name* the main organs in contact with each of the left and right kidneys
4. *Describe* the arterial supply of the kidneys and adrenal (suprarenal)
5. glands
6. *Name* the principal macroscopic components of the kidney and *relate* these to microscopic organisation.
7. *Mark* the likely positions of the kidneys and ureters in a living subject and *demonstrate* their positions in appropriate plain and contrast radiographs and in CT images.
8. *Demonstrate* how to palpate the kidneys in a living subject.
9. *Demonstrate* the main components of the posterior abdominal wall from diaphragm to pelvic inlet.

Session 7 – Male Pelvis and Perineum

**Learning Objectives**

1. *Identify* the component bones of the pelvis and the following landmarks: iliac crest, anterior superior iliac spine, anterior inferior iliac spine, pubic symphysis, pubic tubercle, superior and inferior pubic rami, obturator foramen, ischial tuberosity, ischial spine.
2. *Define* the pelvic diaphragm, *identify* its nerve supply and *indicate* its importance.
3. *Distinguish* structurally and functionally between the pelvis and the perineum.
4. *Describe* the position and relations (including peritoneal) of the bladder and rectum.
5. *Describe* the courses of the ureters from the renal pelvis to the entry into the urinary bladder
6. *Describe* the shape, position and relations of the bladder in the male pelvis when empty and when full
7. *Demonstrate* the positions and *explain* the functions of the ductus deferens, seminal vesicles and the prostate gland.
8. *Explain* the contributions of the internal iliac and the gonadal arteries to the supply of the pelvic organs and walls.
9. *Explain* the relationships of the urethra, urethral sphincter and erectile tissue masses in the male perineum.
10. *Demonstrate* the position and relations of the ischio-anal fossae and *summarise* their importance.
11. *Explain* the anatomical considerations involved in passing a urinary catheter in a male.
12. *Describe* what can be felt in a normal rectal examination in a male.
13. *Explain* the pelvic, perineal and neurological mechanisms responsible for urinary and faecal continence and the likely consequences of spinal cord injuries.
14. *Describe* the venous drainage of the rectum and anal canal and *explain* the occurrence of piles.
15. *Distinguish* the pathway of lymphatic drainage of the perineum from that of the pelvis and *summarise* its clinical significance

Session 8 – Female Pelvis and Perineum

**Learning Objectives**

1. *Demonstrate* the relations between the uterus, uterine (Fallopian) tubes, ovaries, broad ligament and uterine arteries.
2. *Explain* the structure and functions of the cervix in non-pregnant women and in late pregnancy and parturition.
3. *Summarise* the anatomical mechanisms that support the cervix and resist prolapse of the uterus.
4. *Sketch* the relations of the upper vagina to the cervix and the peritoneal cavity and *explain* their significance.
5. *Describe and explain* the clinical importance of the relationship between the ureters and the uterine vessels.
6. *Describe* the arrangement of the female perineum making correct use of the following terms: labia majora and minora, vestibule, greater vestibular glands, clitoris and vestibular bulbs
7. *Summarise* the motor and sensory nerve supply of the perineum
8. *Explain* the clinical significance of the differences between the male and the female urethral sphincter apparatus.

Session 9 – Anatomy of Pregnancy and Parturition

**Learning Objectives**

1. *Explain* the differences between the female and male pelvis and how they facilitate parturition.
2. *Describe*  how the shape of the neonatal skull can alter to facilitate parturition.
3. *Summarise* how pregnancy can affect venous and lymphatic return, the GI-I system, the urinary system and the axial skeleton.
4. *Explain the anatomical basis of episiotomy, and pudendal and ilio-inguinal nerve blocks.*.
5. *Describe* how the foetal head normally engages with and rotates in the pelvis prior to birth.

#### Anatomy of Head, Neck & Spine

Session 1 – Organisation of the skull and meninges

**Learning Objectives**

* Demonstrate on a skull and in radiographs the following bones: frontal, parietal, temporal (squamous, petrous and mastoid process), ethmoid, sphenoid (body and wings) and occipital
* Identify both on the brain and in x-ray, CT and MR images the following: ventricles, cerebral hemispheres, thalamus, hypothalamus, internal capsule, basal ganglia, brainstem, optic chiasm and pituitary gland
* Identify the different tissue components of the scalp
* Demonstrate the relationship between the brain and the different cranial fossae
* Describe the structure and function of the meninges
* Draw a simple diagram to explain the flow of cerebrospinal fluid in and around the brain
* Explain the term herniation with respect to the brain and give examples of its neurological consequences
* Identify on a skull the main exit/entry routes for the cranial nerves and the major blood vessels
* Draw a simple diagram of the Circle of Willis
* Demonstrate the main venous sinuses
* Outline how venous anatomy presents opportunities for intracranial infection
* Identify the pterion and explain the clinical importance of its relationship to the middle meningeal artery

Session 2 – Organisation of the vertebral column

**Learning Objectives**

* Recognise and name the following parts of a typical vertebra in osteological specimens or in suitable imaging: body, pedicle, lamina, transverse process, spinous process, articular surfaces
* Recognise the distinctive features of cervical, thoracic and lumbar vertebrae
* Explain the roles of intervertebral discs, ligaments and muscles in load bearing in the vertebral column
* Describe the relative extents of antero-posterior flexion, lateral flexion and axial rotation in the major regions of the vertebral column and explain this in terms of skeletal anatomy
* Identify the atlas and axis and explain their functions in head movement
* Demonstrate on each other the location of C7, T3, T7, L2 and L4 vertebrae
* State the number of vertebrae in each region of the spine, and how the pairs of spinal nerves are related to them
* Explain the arrangement of the meninges around the spinal cord and roots, and indicate any differences from the cranial meninges
* Identify two major reasons for carrying out lumbar puncture, and explain the basis for the puncture site
* Explain the danger of carrying out lumbar puncture without excluding the presence of raised intracranial pressure
* Outline the steps taken to avoid neurological complication in casualties with a possibility of cervical spine injury
* Explain in anatomical terms the most common causes of back pain
* Describe the most common abnormalities of spinal curvature

Session 3 – Organisation of the neck and face

**Learning Objectives**

* Sketch the thoracic inlet to show the relations of the following structures at the neck-chest interface: 1st thoracic vertebra, 1st ribs and cartilages, manubrium, pleura and lungs, oesophagus, trachea, brachiocephalic veins, vagus nerves, brachiocephalic artery, left common carotid and subclavian arteries, sympathetic trunks, left recurrent laryngeal nerve, phrenic nerves
* Locate the carotid pulse and explain the main uses of this central pulse
* Demonstrate the technique for palpation of the cervical lymph nodes and define their field of drainage
* Define the boundaries of the anterior and posterior triangles of the neck
* Identify the infrahyoid (strap) muscles, mylohyoid and the digastric muscle
* Demonstrate on the living subject and on suitable prosections the position of the roots and trunks of the brachial plexus
* Demonstrate in prosections the position and key relations of the subclavian artery and vein, and brachial plexus
* Demonstrate the courses of the internal thoracic and vertebral branches of the subclavian artery
* Explain the uses of central venous lines and indicate the landmarks for insertion of a central line into the internal jugular vein
* List the possible complications of insertion of central venous lines
* Describe the origin, course and function of the phrenic and spinal accessory nerves

Session 4 – The oral cavity and upper airway/digestive tract

**Learning Objectives**

* Outline the main neuromuscular systems involved in biting, chewing, salivation and swallowing
* Identify the major branches of the external carotid artery (superior thyroid, ascending pharyngeal, lingual, facial, posterior auricular, occipital, superficial temporal, maxillary)
* Assess those functions of the trigeminal, facial, glossopharyngeal, vagus and hypoglossal nerves which relate to biting chewing and swallowing
* Demonstrate how the temporo-mandibular joint and muscles of mastication produce chewing movements
* Demonstrate the routes by which the maxillary, mandibular, facial, glossopharyngeal, vagus and hypoglossal nerves leave the skull, and indicate the courses of the lingual and inferior alveolar nerves
* Describe the relationship between the facial nerve and the parotid gland
* Identify the positions of the parotid and submandibular glands and the lymph nodes draining the oral and oropharyngeal structures
* Identify the teeth in the living mouth and record them accurately; recognise characteristic dental patterns for children and adults
* Be able to identify the following structures in the living mouth: hard and soft palate, uvula, faucial pillars, palatine tonsils, lingual papillae, parotid and submandibular papillae, sublingual glands, frenulum, genioglossal ridge
* Describe the structure and function of the pharyngotympanic (Eustachian) tube
* Understand the relationship of the pharynx to the nasal cavity, oral cavity and larynx
* Demonstrate the sub-regions of the pharynx

Session 5 – Larynx and Auditory Apparatus

**Learning Objectives**

* List the mechanisms that protect the lungs and bronchi against aspiration of food and drink
* Explain (in terms of sensory and motor pathways and muscle *groups*) the sneeze and cough reflexes
* Demonstrate in dissected specimens the landmarks of the nasal cavities, nasopharynx and soft palate
* Demonstrate in living subjects the body of the hyoid, the thyroid and cricoid cartilages, the cervical part of the trachea, and the thyroid isthmus
* Demonstrate in living subjects and imaging the positions of the paranasal sinuses; define their sensory nerve supply; explain the clinical significance of their drainage routes
* Explain the importance of the relationship of the maxillary sinus to the roots of the upper teeth, and of the sphenoid sinus to the pituitary fossa
* Explain pressure equalisation between the pharynx and the middle ear
* Explain the clinical importance of the relationship of the mastoid antrum and the mastoid air cells to the middle ear cavity in the skull
* Identify the features of the external auditory meatus and eardrum that can be seen through an auroscope
* Outline the contributions of the structures and spaces of the airway and oral cavity to voice production
* List the actions that may be taken to restore patency of the airway in an emergency
* Describe the anatomical basis of tracheotomy and cricothyroidotomy
* Explain likely consequences of disease or injury of a recurrent laryngeal nerve and of the superior part of the cervical sympathetic chain

Session 6 – The oral cavity and upper airway/digestive tract

**Learning Objectives**

* Outline the main neuromuscular systems involved in biting, chewing, salivation and swallowing
* Identify the major branches of the external carotid artery (superior thyroid, ascending pharyngeal, lingual, facial, posterior auricular, occipital, superficial temporal, maxillary)
* Assess those functions of the trigeminal, facial, glossopharyngeal, vagus and hypoglossal nerves which relate to biting chewing and swallowing
* Demonstrate how the temporo-mandibular joint and muscles of mastication produce chewing movements
* Demonstrate the routes by which the maxillary, mandibular, facial, glossopharyngeal, vagus and hypoglossal nerves leave the skull, and indicate the courses of the lingual and inferior alveolar nerves
* Describe the relationship between the facial nerve and the parotid gland
* Identify the positions of the parotid and submandibular glands and the lymph nodes draining the oral and oropharyngeal structures
* Identify the teeth in the living mouth and record them accurately; recognise characteristic dental patterns for children and adults
* Be able to identify the following structures in the living mouth: hard and soft palate, uvula, faucial pillars, palatine tonsils, lingual papillae, parotid and submandibular papillae, sublingual glands, frenulum, genioglossal ridge
* Describe the structure and function of the pharyngotympanic (Eustachian) tube
* Understand the relationship of the pharynx to the nasal cavity, oral cavity and larynx
* Demonstrate the sub-regions of the pharynx

Session 7 – Anatomy of the orbit and its contents

**Learning Objectives**

* Describe briefly the margin and walls of the bony orbit and name its important contents
* Test function of the following cranial nerves: oculomotor, trochlear, abducens, ophthalmic division of trigeminal, facial (to orbicularis oculi)
* Identify the rectus and oblique muscles, levator palpebrae superioris and orbicularis oculi in suitable specimens
* Identify on a skull the superior orbital fissure and the optic canal and name the nerves and vessels passing through them
* Explain the clinical significance of the close relationship between the superior orbital fissure and the cavernous sinus
* Describe briefly the arterial supply and venous drainage of the eye, including the retina
* Understand how to test corneal and consensual light reflexes and explain the afferent and efferent components of these
* Identify the optical and neural parts of the eye
* Outline the mechanisms of tear secretion, tear-film maintenance and tear drainage

#### Anatomy of Limbs

Session 1 – Upper limb girdle and upper arm

## Learning Objectives:

Students should be able to:

1. *Name* the bones and joints of the upper limb from the upper limb girdle to the elbow
2. *Demonstrate* the main movements of the upper limb girdle and gleno-humeral joint
3. *Identify* in a living subject and in appropriate imaging;
	1. the clavicle and its sternoclavicular and acromioclavicular joints
	2. the lateral and medial borders and inferior angle of the scapula, the scapular spine, acromion process, coracoid process and glenoid fossa
4. *Name and demonstrate* the position, main attachments and actions of;
	1. pectoralis major
	2. latissimus dorsi
	3. trapezius
	4. serratus anterior
	5. teres major
	6. deltoid
	7. the rotator cuff muscles
5. *List* the spinal nerve roots supplying the upper limb
6. *Demonstrate* the position and boundaries of the axilla
7. *Understand* the general arrangement of the brachial plexus.
8. *Demonstrate* how the major nerves and vessels of the upper limb reach and enter the axilla
9. *Explain* the significance of the term “synovial ball-and-socket joint” using the shoulder joint as an example
10. *Summarise* the main factors stabilising the shoulder joint
11. *Explain* how the stability of the shoulder joint fails in dislocation
12. *Discuss* the difference between acromioclavicular dislocation and shoulder joint dislocation
13. *Explain* the risk to the axillary nerve in shoulder dislocation and the likely consequences of injury to this nerve and *demonstrate* how the function of this nerve can be assessed
14. *Describe* the rotator cuff arrangement of muscles and tendons and explain why the rotator cuff is important in shoulder function and is clinically a common site of pathology. *Outline* the importance of imaging of the shoulder in rotator cuff problems. *Describe* clinical testing of the rotator cuff.
15. *Explain* the anatomical basis of frozen shoulder.
16. *Outline* the main areas supplied by important branches of the subclavian and axillary arteries and *explain* the importance of the anastomosis between these branches
17. *Explain* what is meant by winging of the scapula and its anatomical basis

Session 2 – Elbow, forearm and wrist

**Learning Objectives**

Students should be able to:

1. *Name* the bones and joints of the upper limb from the elbow to the wrist.
2. *Demonstrate* and *explain* the anatomical basis of elbow flexion and extension, pronation and supination of the hand and the movements of the wrist.
3. *Demonstrate* in a living subject the elbow the medial epicondyle, the olecranon process and the lateral epicondyle; the radius and ulna; the wrist joint.
4. *Demonstrate* the courses of the major nerves through the region and also to point out where the nerves might be vulnerable to injury.
5. *Demonstrate* the courses of the brachial, radial and ulnar arteries from the axilla to the hand.
6. *Demonstrate* the pulses associated with the brachial, radial and ulnar arteries.
7. *Demonstrate* and *name* the main veins of the upper limb.
8. *Demonstrate* clinical testing of the muscles, tendon, nerves and vessels in the forearm.
9. *Discuss* a supracondylar fracture of the humerus and *explain* why this common injury can cause significant vascular and neurological complications.
10. *Describe* a Colles fracture, and *explain* why it is so common?

Session 3 – Wrist and Hand

**Learning Objectives**

1. *Name* the bones and joints of the wrist and hand
2. *Name* and *demonstrate* the movements of the wrist and hand
3. *Distinguish* between the power and precision grips
4. *Outline* the main neuromuscular mechanisms underlying each type of grip
5. *Summarise* in simple terms the overall pattern of motor and sensory segmental nerve distribution to the limb
6. *Explain* (in principle only) the role of the brachial plexus
7. *Explain* the main motor and sensory deficits associated with carpal tunnel syndrome, ulnar nerve injury near the elbow, radial nerve injury in the spiral groove, injury to the lower segments of the brachial plexus
8. *Outline* the functional deficits caused by the common injuries of the flexor and extensor tendons
9. *Outline* the mallet finger deformity
10. *Identify* and *summarise* the functions of the carpal bones
11. *Describe* how fractures of the scaphoid occur and explain why such injuries are important
12. *Discuss* the clinical term, trigger finger
13. *Describe* gamekeeper’s thumb (skier’s thumb) and its anatomical basis.

Session 4 – Brachial plexus, nerves and vessels of the upper limb

**Learning Objectives**

Students should be able to:

1. *Contrast* the segmental and peripheral nerve distribution to the upper limb
2. *Describe* the brachial plexus
3. *Outline* the segmental nerve supply to the upper limb
4. *Outline* the peripheral nerve supply to the upper limb
5. *Discuss* clinical evaluation of segmental nerve injuries affecting the upper limb
6. *Discuss* clinical evaluation of peripheral nerve injuries affecting the upper limb
7. *Describe* the arterial supply of the upper limb
8. *Describe* the venous drainage of the upper limb
9. *Describe* the lymphatic drainage of the upper limb
10. *Discuss* clinical methods of evaluation of the vascular supply and drainage of the upper limb
11. *Discuss* vascular access in the upper limb.

Session 5 – Lower limb girdle, buttock and proximal thigh

**Learning Objectives**

After studying the content of this session you should be able to:

1. *Identify* the bones and joints of the lumbo-sacral region, hip joint and femur
2. *Find* the following landmarks in the living subject: the mid-inguinal point, the anterior superior iliac spine, the symphysis pubis and the pubic tubercle, the greater trochanter, the medial and lateral femoral epicondyles
3. *Demonstrate* the following prime movers and muscle groups and the main movements associated with them;
	1. gluteus maximus
	2. hip abductors
	3. ilio-psoas
	4. hip adductors
	5. the hamstrings
	6. quadriceps femoris
	7. sartorius
4. *Describe* the anatomical relations of the superior gluteal, inferior gluteal, sciatic and obturator nerves
5. *Demonstrate* the femoral pulse and *explain* its significance
6. *Discuss* femoral neck fractures.
7. *Explain* the difference between intracapsular fractures and extracaspsular fractures of the femoral neck and their clinical importance
8. *Describe* the Trendelenberg test
9. *Briefly describe* the principles behind total hip replacement.

Session 6 – Thigh and knee

**Learning Objectives**

After studying the content of this session you should be able to:

1. *Demonstrate* the boundaries of the femoral triangle and *describe* its contents
2. *Find* the following landmarks in the living subject;
	1. the medial and lateral femoral epicondyles
	2. the patella and the patellar ligament
	3. the head of the fibula
3. *Demonstrate* the following prime movers and muscle groups and the main movements associated with them;
	1. anterior compartment of the thigh
	2. posterior compartment of the thigh (hamstrings)
	3. medial (adductor) compartment of the thigh
4. *Assign* muscle groups to the following nerves;
	1. the femoral nerve
	2. the obturator nerve
	3. the sciatic nerve in the thigh
5. *Trace* the routes of the femoral artery, the profunda femoris artery, the popliteal artery
6. *Demonstrate* the femoral pulse, the popliteal pulse, and explain their significance
7. *Identify* the bones and their major features at the knee joint
8. *Identify* the ligaments of the knee joint and *understand* their role in joint stability and movement
9. *Briefly explain* the operation of total knee replacement and potential damage during the operation
10. *Describe* arthroscopy of the knee joint
11. *Discuss* the common injury of anterior cruciate ligament rupture.

Session 7 – Leg, Ankle and Foot

**Learning Objectives**

After studying the content of this session you should be able to:

* *Identify* the bones and joints of the entire lower limb
* *Find* the following landmarks in the living subject;
	+ The boundaries of the popliteal fossa
	+ the medial and lateral femoral epicondyles
	+ the patella and the patellar ligament
	+ the head of the fibula
	+ the medial and lateral malleoli
	+ the navicular tuberosity
	+ the base of the fifth metatarsal
	+ the head of the first metatarsal
* *Demonstrate* the following prime movers and muscle groups and the main movements associated with them;
	+ the gastrocnemius-soleus (the superficial flexor compartment of the leg)
	+ the deep flexor compartment of the leg
	+ the peroneal compartment of the leg
	+ the extensor compartment of the leg
* *Assign* muscle groups to the following nerves:
	+ the tibial nerve
	+ the common peroneal nerve
* *Trace* the routes of the popliteal artery, the anterior tibial artery and the posterior tibial artery
* *Demonstrate* the popliteal pulse, the posterior tibial pulse and the dorsalis pedis artery and explain their significance
* *Briefly explain* the operation of total knee replacement and potential damage during the operation
* *Describe* arthroscopy of the knee joint
* *Discuss* the common injury of anterior cruciate ligament rupture.
* *Discuss* Achilles Tendon Ruptures and their anatomical bases
* *Discuss* the clinical entity of compartment syndrome and *explain* its anatomical basis.

Session 8 – Lumbo-sacral plexus, nerves and vessels of the lower limb

**Learning Objectives**

After studying the content of this session you should be able to:

* *Identify* the bones and joints of the entire lower limb
* *Find* the following landmarks in the living subject;
	+ The boundaries of the popliteal fossa
	+ the medial and lateral femoral epicondyles
	+ the patella and the patellar ligament
	+ the head of the fibula
	+ the medial and lateral malleoli
	+ the navicular tuberosity
	+ the base of the fifth metatarsal
	+ the head of the first metatarsal
* *Demonstrate* the following prime movers and muscle groups and the main movements associated with them;
	+ the gastrocnemius-soleus (the superficial flexor compartment of the leg)
	+ the deep flexor compartment of the leg
	+ the peroneal compartment of the leg
	+ the extensor compartment of the leg
* *Assign* muscle groups to the following nerves:
	+ the tibial nerve
	+ the common peroneal nerve
* *Trace* the routes of the popliteal artery, the anterior tibial artery and the posterior tibial artery
* *Demonstrate* the popliteal pulse, the posterior tibial pulse and the dorsalis pedis artery and explain their significance
* *Briefly explain* the operation of total knee replacement and potential damage during the operation
* *Describe* arthroscopy of the knee joint
* *Discuss* the common injury of anterior cruciate ligament rupture.
* *Discuss* Achilles Tendon Ruptures and their anatomical bases
* *Discuss* the clinical entity of compartment syndrome and *explain* its anatomical basis.

### THEME: Regulatory Systems

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### Gerontology

**Module Leader:** Dr Nigel Beckett

#### Learning outcomes

By the end of the course the students should:-

1. Be aware of the main theories of ageing and at least one in more detail
2. Have an understanding of the demographic changes occurring within society and the implications of these changes to health care services
3. Gain an insight into the difficulties faced in managing health care problems in older people
4. Be able to discuss strategies to promote healthy ageing
5. Have an understanding of the age related changes that occur within cardiovascular system and their impact on manifestation of cardiovascular disease in older people.
6. Be aware of the changes, both physical and functional, that occur with ageing in the brain.
7. Be aware of the altered presentation of disease with age and how to assess older adults with healthcare problems
8. Have an overview of the age-associated changes that occur within other body systems.
9. Have an understanding of the concept of frailty.

### Endocrinology

**Module Leader:** Dr Duncan Bassett and Dr Jeannie Todd

#### Learning Outcomes

**Session 1 – Overview of Endocrinology/Intro to endocrine system**

1. Define the terms hormone, endocrine gland, neurotransmitter and neurosecretion.

2. Identify the features which distinguish endocrine from paracrine and autocrine systems.

3. State that most hormones can be classified either as protein (and polypeptide) or steroid hormones, but that a few do not fall easily into either of these two groups and therefore form a third group.

4. Describe the principal stages of protein/polypeptide hormone synthesis, how they are stored and the mechanism of their secretion into the circulation.

5. Describe the different types of membrane receptor and the intracellular mechanisms of action induced by hormones.

6. Explain how steroid hormones are synthesised and released into the circulation.

7. Describe the receptors and mechanisms of action of steroid hormones.

1. Define the terms negative and positive feedback and explain how any individual hormone system is controlled.

**Session 2 – Hypothalamo-pituitary axis & anterior pituitary disorders**

**Learning Objectives**

**Hyposecretion states:**

1. Define the term pan-hypopituitarism (Simmond’s disease) and describe the specific aetiology of the form of hypopituitarism called Sheehan’s syndrome.
2. Describe the more common signs and symptoms of pan-hypopituitarism.
3. Describe how a) anatomical pituitary disruption and b) pituitary hormone deficiency can be evaluated, including the use of stimulation tests.
4. Describe how the endocrine consequences of pan-hypopituitarism can be treated, using the term hormone replacement therapy
5. List the various possible individual pituitary hormone deficiencies that can occur and explain how the conditions can be diagnosed and treated (when appropriate).
6. List the principal endocrine causes of short stature, identifying those that are caused by lack or excess of specific hormones and those that are related to receptor and post-receptor defects (e.g. Laron dwarf).
7. State that short stature can also be related to non-endocrine causes such as malabsorption, malnutrition and psychological deprivation.
8. Explain how the diagnosis of endocrine-related short stature can be made, including a description of the use of standard growth charts and stimulation tests.
9. Explain why provocative tests are useful in the diagnosis of pituitary insufficiency. Give examples of tests used to diagnose GH deficiency.
10. Describe the pharmacodynamic and pharmacokinetic properties of human growth hormone (hGH) and explain the rationale governing its use in the treatment of GH deficiency in (a) children and (b) adults.

**hypersecretion states:**

1. Explain why suppression tests are useful in the diagnosis of excessive pituitary hormone secretion. How do the GH responses to oral glucose differ in acromegalics and normal subjects?
2. List the techniques available to examine the hypothalamo-hypophysial axis for the presence of tumours, identifying the different sites where such a tumour might be present.
3. List the individual pituitary hormone excess states that can develop, and describe the principal consequences of each hypersecretory state.
4. Describe the principal signs and symptoms of growth hormone hypersecretion in the child and the adult.
5. Describe how gigantism and acromegaly are diagnosed.
6. List the principal treatments available for the treatment of gigantism and acromegaly.
7. State that prolactinoma is the most common tumour of the pituitary gland.
8. Describe the principal signs and symptoms of hyperprolactinaemia.
9. Describe how hyperprolactinaemia is diagnosed.
10. List the principal treatments available for the treatment of hyperprolactinaemia.
11. Explain why hyperthyroidism, precocious puberty and Cushing’s syndrome can be primary, secondary (or even tertiary) disease states depending on the site of the lesion.
12. Name two dopamine receptor agonists used in the treatment of hyperprolactinaemia. Explain the unwanted effects of these drugs and note their main pharmacokinetic features.
13. Name a somatostatin analogue used in the treatment of growth hormone excess and describe its main biological actions and pharmacokinetic features. List the potential unwanted effects of these drugs and identify other conditions in which they may also be useful.
14. State that acromegaly may also be treated with dopamine receptor agonists.

**Session 3 – Posterior Pituitary Physiology Disorders and Appetite and Obesity**

**Posterior Pituitary Physiology Disorders**

**Learning Objectives**

1. List the major biological responses that occur following stimulation of (a) V1- and (b) V2 receptors.
2. Describe and explain the signs and symptoms of diabetes insipidus.
3. List the principal causes of diabetes insipidus.
4. Explain the difference between central (cranial) and nephrogenic diabetes insipidus.
5. Explain how the two forms of diabetes insipidus can be diagnosed and differentiated from each other, and from (psychogenic) polydipsia.
6. Note that while the central form of diabetes insipidus is treated with desmopressin, the nephrogenic form is treated with thiazide diuretics.
7. Describe the signs and symptoms of the syndrome of inappropriate ADH (SIADH) and relate them to the physiological actions of vasopressin.
8. List the principal causes of SIADH.
9. Describe how SIADH and its manifestations can be treated.
10. Classify the vasopressin receptors in terms of (a) ligand selectivity and (b) the signal transduction mechanisms they employ. Identify the main sites in the body where (a) type 1 and (b) type-2 vasopressin receptors (V1 and V2 receptors) are found and note the differential distribution of V1 receptors within the vasculature.
11. Describe major clinical uses and unwanted effects of argipressin (arginine vasopressin), the V2-selective agonist desmopressin (DDAVP) and the V1-selective agonist terlipressin. Identify the routes by which these drugs are given and explain why desmopressin has a longer half-life than argipressin.

**Appetite and Obesity**

1. Explain the concept of energy homeostasis.
2. List major hormones and other peripheral factors that control appetite.
3. Describe the functions of the fat hormone leptin.
4. Understand the role of the hypothalamus and brainstem in controlling appetite.
5. Name the major hypothalamic nuclei and neuropeptides that regulate appetite.
6. Name higher brain centres involved in food reward systems.
7. Understand the contributions to daily energy expenditure.
8. Understand the concept of body mass index and the definitions of obesity.
9. Understand the scale of the obesity epidemic.
10. List the complications of obesity.
11. List the features of the metabolic syndrome
12. Understand the importance of body fat distribution and the factors that influence it.
13. Understand the medical risks of obesity and the benefits of moderate weight loss.
14. List the major causes of obesity.
15. Understand the principles behind the management of obesity and the treatment options available.

**Session 4 – THE ENDOCRINE PANCREAS AND THE PATHPHYSIOLOGY OF TYPES 1 AND 2 DIABETES MELLITUS**

**Learning Objectives**

1. Explain why the blood glucose concentration is closely regulated and list the hormones that control it.
2. Draw a labelled diagram illustrating the relationship between the different types of cell in the islets of Langerhans, describe the endocrine pancreas.
3. Give an overview of the principal metabolic pathways for carbohydrates, proteins and fats, and the hormones that regulate these pathways.
4. Describe the structure of a typical islet of Langerhans, identifying the different cellular components and their principal endocrine secretions.
5. Describe the main features of insulin synthesis, storage and secretion.
6. List and describe the principal actions of insulin
7. Discuss the insulin receptor and its function.
8. Draw a labelled diagram illustrating the factors which regulate the release of insulin.
9. Describe the synthesis, storage and secretion of glucagon.
10. List and describe the principal actions of glucagon.
11. Draw a labelled diagram illustrating the factors which regulate the release of glucagon.
12. Describe in your own words what the diagnosis of diabetes means to patients (video)
13. Describe the beta-cell sensing mechanism of glucose
14. Describe the endocrine regulation of intermediary metabolism
15. List the principal signs and symptoms of diabetes mellitus, and relate them to the underlying pathophysiology.
16. Distinguish between Diabetes Mellitus types 1 and 2.
17. To understand the definition & classification and explain the aetiology type 1 diabetes and of type 2 diabetes mellitus.
18. Define insulin resistance and explain how it is related to diabetes, dyslipidaemia, hypertension and ischaemic heart disease.
19. Describe the consequences of insulin resistance on glucose, lipid and protein metabolism
20. Describe the physiology and risks of obesity.
21. Describe the pathophysiology of type 2 diabetes
22. To understand the basis of the immunological mechanisms responsible for β-cell loss
23. To understand the biochemical effects of insulin deficiency
24. To understand the principles of insulin treatment in type 1 diabetes
25. To understand the physiology and treatment of hypoglycaemia.
26. To understand the physiology and treatment of diabetic ketoacidosis.
27. To compare and contrast T1 and T2 DM
28. To review the epidemiology of T2DM
29. To describe the aetiology and pathophysiology of T2DM
30. To describe the treatments for hyperglycaemia with respect to the physiology of T2DM
31. To discuss diabetes control beyond hyperglycaemia
32. After the whole day the student should understand the pathophysiology, the principles of treatment, the complications of diabetes mellitus and the basis of diabetes patient education.

**Session 5 – MINERAL METABOLISM AND METABOLIC BONE DISORDERS**

**Learning Objectives**

1. Describe the formation of the skeleton and contrast endochondral and intramembranous ossification
2. How is the structural integrity of the skeleton maintained? Describe the role and regulation of the bone cells involved
3. Identify the principal organs involved in calcium metabolism
4. Describe the mechanism of action of PTH, 1,25(OH)2D and FGF23
5. Describe the regulation of parathyroid hormone synthesis and secretion
6. List the functions of calcium in the body.
7. Describe the regulation of vitamin D metabolism
8. List the functions of phosphate in the body
9. Describe how PTH, 1,25(OH)2D are synthesized.
10. Describe the negative feedback loops involved in calcium and phosphate homeostasis
11. Contrast the regulation of 1,25(OH)2D synthesis in kidney and macrophages
12. Contrast the signalling of FGF23 and 1,25(OH)2D
13. Explain why calcitonin is not thought to be an important regulator of mineral homeostasis in humans
14. How does 1,25(OH)2D integrated the regulation of calcium and phosphate
15. List the principal causes of hypocalcaemia.
16. List the principal causes of hypercalcaemia.
17. Describe the causes of rickets the pathology the mechanism.
18. Distinguish between primary, secondary and tertiary hyperparathyroidism.
19. Describe the investigation and management of primary hyperparathyroidism
20. Describe the common signs and symptoms of vitamin D deficiency in children and adults
21. How would you diagnose vitamin D deficiency?
22. Describe the pathological changes in rickets
23. Describe the causes of hypercalcaemia with an undetectable PTH
24. Describe the pathology, main clinical features and diagnosis of Paget’s disease.
25. Draw a simple flow diagram illustrating how chronic renal failure effects PTH, 1,25(OH)2D and FGF23
26. Why is calcitrioland notergocalciferol used to treating bone disease in chronic renal failure
27. List the common risk factors for osteoporosis i.e. age, and explain their actions in terms of calcium metabolism.
28. Describe preventative measures used in osteoporosis treatment and explain their actions in terms on bone metabolism.
29. Describe DXA BMD analysis with particular reference to the T and Z scores
30. Define the incidence of osteoporosis and explain briefly its implications on NHS resources, patient mobility, and mortality.
31. Describe the indications for treatment of Paget’s disease and the mechanism of action of the therapy.
32. Describe the skeletal consequences of long-term glucocorticoid treatment
33. List the common endocrine diseases associated with osteoporosis.
34. List the principal causes of Hypercalcaemia, and describe the common signs and symptoms associated with this condition.
35. Identify the differences between primary and secondary hyperparathyroidism and explain why these two diseases would be treated differently.
36. Name the main medications used to treat osteoporosis and describe their action.
37. Explain why vitamin D may be termed a hormone precursor and a pro-drug.
38. Describe the actions and uses of bisphosphonates and explain why care should be taken when administering these drugs to patients with renal insufficiency.
39. To which superfamily of receptors do the VDR and ER belong and how do they bring about their actions within the cell.
40. Compare and contrast the uses of PTH and the bisphosphonates.
41. Describe the different treatment strategies for osteoporosis.

**Session 6 – NORMAL REPRODUCTIVE FUNCTION AND PREGNANCY**

**Learning Objectives**

132. Identify the principal features of the control systems operating on the production of the gonadal steroids, with particular reference to negative and positive feedback loops, in males and females.

133. Label diagrams illustrating the principal structures of the testes and ovaries.

134. Draw simple flow charts illustrating the synthesis of progesterone, 17b-oestradiol and testosterone.

135. Describe the actions of the gonadal steroids in males and females.

136. Describe the principal ovarian and endometrial changes that occur during the menstrual cycle.

137. Relate the synthesis of the major gonadal steroids in males and females to the relevant hormones of the hypothalamo-adenohypophysial axis.

138. Describe how the cyclic production of ovarian steroids is linked to the endometrial, cervical and other changes of the menstrual cycle.

139. Describe the necessary changes which have to occur before the spermatozoon

becomes fully capable of fertilizing the ovum (including capacitation).

140. Describe the fertilization process.

141. Describe how implantation occurs.

142. Describe the decidualization reaction.

143. Describe the principal physiological role of hCG and identify the stage in pregnancy when it first appears and when it peaks.

144. Draw a chart illustrating the changes in maternal circulating concentrations of oestrogen, progesterone, hCG, hPL, LH and FSH throughout pregnancy.

145. Explain how hormones regulate lactation.

146. Draw a diagram of the hypothalamo-pituitary gonadal axis in primary and secondary gonadal failure

147. List the clinical features, causes, investigations and treatment of male

hypogonadism

148. Define primary and secondary amenorrhoea

149. List the causes, investigations and treatment of amenorrhoea

150. List the criteria used to diagnose PCOS

151. List the clinical features, investigations and treatment of PCOS

152. Draw a diagram of the pathway controlling normal prolactin secretion

153. List the causes, clinical features, investigation and treatment of hyperprolactinaemia

154. Define the term menopause

155. List the symptoms of menopause

156. List the complications of menopause

157. Understand the advantages and disadvantages of treatment of menopause with HRT, Tibolone

**Session 7 – Thyroid physiology and thyroid disorders**

**Learning Objectives**

1. Describe the development of the thyroid
2. Describe anatomy of the thyroid and the structure of the follicles.
3. List hormones produced by the thyroid.
4. Describe principal features of iodothyronine synthesis, storage, release.
5. Describe the physiological actions of the iodothyronines.
6. Explain the mechanism of action of the iodothyronines.
7. Describe the control of iodothyronine production with particular reference to the hypothalamus-pituitary-thyroidal axis.
8. Explain the role of the iodothyroninediodinases in the regulation of systemic thyroid hormone concentration and local thyroid hormone action.
9. Contrast the mechanism of action of TSH and T3

**Thyroid hormone deficiency**

1. Understand the difference between Cretinism and congenital hypothyroidism
2. Describe neonatal screening with the Guthrie test
3. Describe the clinical features of thyroid hormone deficiency in children and adults
4. Understand the aetiology and differential diagnosis of thyroid hormone deficiency
5. Describe the investigation of and treatment of hypothyroidism
6. Understand the principles of thyroid hormone replacement therapy
7. Understand the principles of treatment issues in the individual patient.
8. Understand the effect of pregnancy on thyroid hormone replacement
9. List the major unwanted effects of replacement therapy with thyroid hormones.

**Thyroid hormone excess**

1. Understand the aetiology and differential diagnosis of thyroid hormone excess
2. Describe the potential effects of the immune system on the thyroid gland
3. Describe the clinical features of hyperthyroidism, Graves’ disease and thyroid storm
4. Describe the investigation of and treatment of hyperthyroidism
5. Understand the mechanism of action of the different thioureylenes, potassium iodine and radioactive iodine

**Thyroid Hormone resistance**

1. Understand the genetic abnormality and clinical and biochemical manifestations of resistance to thyroid hormone

**Thyroid neoplasia**

1. Understand the differential diagnosis and investigation of a thyroid mass
2. Describe the molecular pathogenesis of Papillary, Follicular, Medullary and Anaplastic thyroid carcinoma
3. Understand the risk factors and prognosis in differentiated thyroid cancer
4. Understand the importance of genetic screening and prophylactic thyroidectomy in medullary thyroid carcinoma
5. Describe the treatment and follow up in differentiated thyroid cancer.

**Session 7 – ADRENAL PHYSIOLOGY AND ADRENAL DISORDERS**

**Learning Objectives**

1. Describe the anatomy of the adrenal glands
2. Understand adrenal steroid synthesis
3. Describe where catecholamines are synthesised in the adrenal gland
4. Explain how cortisol, aldosterone and adrenaline are regulated
5. List the physiological roles of cortisol, aldosterone and adrenaline
6. Understand how to describe and diagnose:
* Adrenocortical failure – Addison’s disease, Congenital Adrenal Hyperplasia (CAH)
* Cushing’s syndrome: XS cortisol
* Conn’s syndrome: XS aldosterone
* Phaeochromocytoma: XS catecholamines

### Musculoskeletal System

**Module Leader:** Prof Matthew Pickering

#### Learning outcomes

**Muscle physiology and pathology**

**Lecture: Molecular basis of muscle contraction** (Valentina Caorsi)

Learning Outcomes: Students will be able to:

1. Describe the actin-myosin cross-bridging cycle
2. Describe the organisation of individual myocyte and motor unit
3. Describe the processes involved in depolarisation and intracellular calcium flux
4. Describe the structure of the thin and thick filaments in muscle

**Lecture: Molecular basis and features of the muscular dystrophies** (Matthew Pickering)

Learning Outcomes: Students will be able to:

1. Define muscular dystrophy
2. Understand how muscular dystrophies may be inherited. Give one example of X-linked, autosomal recessive and autosomal dominant muscular dystrophy
3. Understand how these conditions manifest clinically (***NB detailed knowledge of individual syndromes is not required***)
4. Explain the histological differences between myopathy and dystrophy
5. Understand the significance of an elevated blood level of creatinine kinase (also termed creatinine phosphokinase and referred to commonly by physicians as ‘CK’ or ‘CPK’).

**Lecture and practical session: Electromyography** (Nofal Khalil)

Learning Outcomes: Students will be able to:

1. Understand how electromyography differentiates between myopathic and neuropathic lesions
2. Give examples of when this investigation might be used in the clinic

**Lecture: Energy pathways in muscle and the metabolic myopthies** (Federico Roncaroli)

Learning Outcomes: Students will be able to:

1. Describe the bioenergetics of muscle contraction
	* Short-term energy source: role of creatinine phosphate, creatinine kinase and myokinase
	* Intermediate-term energy source: anaerobic glycolysis i.e. the break-down of glucose to lactate and pyruvate and conversion of ADP to ATP (mainly type II fibres that have few mitochondria and many glycogen granules)
	* Long-term energy source: oxidative phosphorylation i.e. aerobic process that generates ATP from fat, carbohydrate and protein (type I fibres are suited to this as thay have many mitochondria and lipid droplets)
2. Understand the different types of metabolic myopathy
	* Briefly describe the key types of primary metabolic myopathies i.e. (1) glycogen storage disorders, (2) lipid disorders and (3) mitochondrial disorders (***NB detailed knowledge of individual syndromes is not required***)
	* Describe the common glycogen storage disorder: Myophosphorylase deficiency (also termed: McArdle’s syndrome, glycogen storage disorder type V)

**Bone and joint physiology**

**Lecture: Bone metabolism and development** (Duncan Bassett)

Learning Outcomes: Students will be able to:

1. Define bone structure
2. Explain the difference between intramembranous and endochondral ossification
3. Define the role of the osteoblast, osteoclasts and chondrocyte
4. Outline the bone remodeling cycle in adult bone
5. Define osteoporosis, list its common causes and outline treatment strategies that may be used
6. Define Paget’s disease and the bone pathology seen in this disorder

**Lecture: Connective tissue and articulations: structure and function** (Matthew Pickering)

Learning Outcomes: Students will be able to:

1. List the main components of the extracellular matrix
2. Know the principal type of collagen in bone and articular (hyaline) cartilage
3. List the main collagen-cleaving enzymes (collagenases)
4. Describe what is meant by synarthrosis, diarthrosis, amphiarthrosis
5. Describe the structure of articular cartilage and synovium
6. List the key features of the heritable collagen disorders: osteogenesis imperfecta, Marfan’s syndrome and Ehlers-Danlos syndrome.

**Lecture: Articular pathology, bone injury and repair** (Matthew Pickering)

Learning Outcomes: Students will be able to:

1. Define what is meant by matrix metalloproteinase and give some examples of their substrates
2. Define what is meant by ADAMTS protease and understand that aggrecanases are important in the turnover of proteoglycan in articular cartilage
3. Understand that cathepsin K is important protease in bone matrix turnover
4. Define two abnormalities seen in the synovium of patients with rheumatoid arthritis
5. Understand the importance of the inflammatory cytokine, tumour necrosis factor-α (TNF-α) in rheumatoid arthritis pathology.
6. Define two abnormalities seen in the cartilage and two abnormalities seen in the bone in the osteoarthritic joint.

**Rheumatology**

**Lecture: Rheumatoid arthritis, Osteoarthritis and Reactive arthritis** (Marina Botto)

Learning Outcomes: Students will be able to:

1. describe the pathogenesis, clinical features and management of rheumatoid arthritis
2. understand the significance of a ‘rheumatoid factor’
3. understand the importance of anti-CCP antibodies in rheumatoid arthritis
4. describe the typical joints affected by osteoarthritis
5. define the term ‘reactive arthritis’ and summarise how it may present
6. understand that ‘reactive arthritis’ is part of a family of inflammatory arthritic syndromes termed ‘seronegative spondyloarthroapthies’ *(****NB detailed knowledge of these conditions is not required****)*

**Lecture: The Connective Tissue Disorders** (Clare Thornton)

Learning Outcomes: Students will be able to:

1. describe the pathogenesis and clinical features of SLE
2. understand the importance of autoantibody measurement in the assessment of connective tissue disease and list the important antibodies associated with (1) SLE, (2) scleroderma, (3) Sjogren’s syndrome and (4) polymyositis
3. briefly list the key features of Sjogren’s syndrome, scleroderma and polymyositis *(****NB detailed knowledge of these conditions is not required****)*
4. understand what is meant by the term ‘overlap syndrome’ in the setting of connective tissue disease

**Lecture: Musculoskeletal Examination** (Francesco Carlucci)

Learning Outcomes: Students will be able to:

1. describe and perform the GALS examination
2. define the following commonly used rheumatological terms: arthritis, arthralgia, subluxation, synovitis
3. describe the pattern of joint disease in rheumatoid arthritis, osteoarthritis and reactive arthritis

**Lecture: Synovial fluid analysis** (Matthew Pickering)

Learning Outcomes: Students will be able to:

1. understand the importance of arthrocentesis and its general contraindications and potential complications
2. describe the clinical features of gout
3. describe the crystals seen within the synovial fluid in gout
4. describe the role of synovial fluid examination in septic arthritis

### Neuroscience

**Module Leader:** Dr Paola Piccini

#### Learning Outcomes

***NMH Session 1:*****The central nervous system: Neuroanatomy of the brain, spinal cord, CSF and meninges**

*Learning objectives*

**Neuroanatomy of the brain, spinal cord, CSF and meninges**

* 1. Explain the relationship between the following major divisions of the CNS:

Spinal cord, brainstem, cerebellum, diencephalon, cerebral hemispheres

* 1. State the functions of the basal ganglia and the cerebellum
	2. Be able to locate the following components of the brain:

Cerebral hemisphere Lateral fissure Optic chiasm

Corpus callosum Central sulcus Infundibulum

Frontal lobe Parieto-occipital fissure Cerebellum

Parietal lobe Primary cortical areas Midbrain

Occipital lobe Basal ganglia Pons

Temporal lobe Thalamus Medulla

* 1. Describe the 3 layers of the meninges and explain their role in protecting the brain
	2. Identify the components of the ventricular system and relate them to the divisions of the CNS
	3. Explain the composition, circulation and functions of CSF

***Session 2:* Brain, brainstem, cranial nerves and spinal cord**

*Learning objectives*

**Brainstem, cranial nerves and spinal cord**

* 1. Define the three components of the brainstem
	2. Draw a diagram of a cross-section through the spinal cord, labelling the main areas of grey matter and main ascending and descending tracts.
	3. With the aid of diagrams show the approximate position of the following structures in the brainstem and state their function:

 Inferior medullary olive Substantia nigra Superior and inferior colliculi

 Reticular formation Locus coeruleus

* 1. Explain the origin and functions of cranial nerves III to XII
	2. Define the function of the cells in the dorsal, ventral and intermediate horns of the spinal cord
	3. Distinguish between the terms nerve, root and ramus in relation to the spinal cord
	4. Explain the relationship between spinal and vertebral levels and its clinical significance
	5. State at which level a lumbar puncture is usually performed and explain why. Why is it hazardous to perform lumbar puncture in the presence of raised intracranial pressure?
	6. Demonstrate in diagrams the course of the following main ascending and descending tracts through the CNS and define their function:

Corticospinal tract Spinothalamic tract Dorsal columns-medial lemniscus

**History of neuroscience**

* 1. To understand the historical basis for interest in the brain and nervous system
	2. To understand the development (and limitations) of anatomical, physiological, biochemical, and molecular approaches to neuroscience
	3. To appreciate that neurology has social and ethical as well as scientific dimensions

*Session 3:* **Cells of the nervous system & Anatomy of blood flow in the CNS and consequences of disruption**

**Cells of the nervous system**

* 1. Draw and label a diagram of a typical neuron, identifying soma, dendrites, axon and terminals.
	2. Define the role of each cellular component in the specialised function of the neuron.
	3. Outline the organisation and functions of intracellular transport in the neuron.
	4. Define the functional subtypes of neurons and list the ways in which they are organised collectively in the nervous system.
	5. Describe the organisation of synapses.
	6. Name the main classes of neuroglia and explain their functions in the nervous system.

**Anatomy of blood flow and consequences of its disruption**

* 1. Learn the blood supply to the CNS, including:
	2. Circle of Willis
	3. Cerebral arteries
	4. Main branches of the vertebrobasilar tree
	5. Understand the perfusion fields for the three main cerebral arteries and explain briefly the neurological deficits that might arise following their disruption.
	6. Outline the pattern of venous drainage of the brain.
	7. Define the following terms:
	+ Cerebral ischaemia
	+ Cerebral infarction
	+ Cerebral thrombosis
	+ Cerebral embolism
	+ Cerebral haemorrhage
	1. Explain what is meant by the terms “stroke” and “transient ischaemic attack” and list the main risk factors for these conditions.
	2. Contrast the effects of a cerebrovascular accident in the cerebral cortex with one in the brainstem (specific deficit vs. unconsciousness, paralysis or combined effects).
	3. Explain the possible consequences of a subdural or epidural haemorrhage.

**Session 4: Development of the Central Nervous System**

* 1. Review the development of the neural tube from the neurectoderm, and give an example of a clinical condition which results from abnormal development.
	2. Explain what is meant by the neural crest cells, and give examples of their developmental fates.
	3. Briefly describe how a simple tubular structure (the early neural tube) can give rise to the shape of the mature brain through differential growth and flexures.
	4. Outline the cellular basis of formation of the ependymal, grey matter (mantle layer) and white matter (marginal layer) regions of the spinal cord, and the separation of the grey matter into sensory (alar) and motor (basal) regions.
	5. Briefly outline how the development of the brainstem diverges from that of the spinal cord.
	6. Briefly outline how cerebral cortical layers form from the neuroepithelium.
	7. Give examples of how an understanding of neuroembryology may help in the treatment of neurological disorders.

**Session 5: Neurotransmitters of the brain & Cortical motor function**

**Neurotransmitters of the brain**

* 1. Describe the features of neurotransmitter release that enable rapid transfer of information between neurones
	2. Define the basic properties of ion channel-linked receptors and G protein-coupled receptors (GPCRs)
	3. Describe the molecular and physiological characteristics of excitatory and inhibitory neurotransmission in the CNS
	4. Understand how receptor subunits produce physiological diversity and how this has formed the basis for drug treatments that target the GABA receptor
	5. Define the major glutamate receptor subtypes
	6. Understand how the channel properties of the NMDA receptor underlie synaptic plasticity
	7. Define the main characteristics of dopamine, noradrenaline and 5-hydroxytryptamine (5-HT) receptors and outline the major pathways where these receptors are found in the brain.

**Control of movements: Brain Control of Movements**

* 1. Understand the levels of hierarchy in motor control.
	2. Describe the location of the primary motor cortex, premotor cortex (PMA) and supplementary motor area (SMA).
	3. Describe the somatotopic organization of the “motor homunculus”
	4. Describe the role of primary motor cortex in voluntary movements
	5. Explain the role of the premotor cortex and supplementary motor area in motor tasks.
	6. Know the organisation of the corticospinal tracts from the motor cortex to the brainstem and spinal cord.
	7. Know the difference in role of the pyramidal and the extrapyramidal systems.
	8. Describe the constellation of symptoms due to corticospinal tract lesions.

**Session 6:Spinal cord, brainstem and cranial nerves**

* 1. Identify the following structures:

Cerebral hemisphere Thalamus

Corpus callosum Hypothalamus

Frontal lobe Optic chiasm

Parietal lobe Infundibulum (stalk of pituitary)

Occipital lobe Cerebellum

Temporal lobe Brainstem

Basal ganglia

* 1. Name the components of the ventricular system.
	2. Which parts of the ventricular system relate to (i) the cerebral hemisphere, (ii) the diencephalon, (iii) the midbrain and (iv) the pons and medulla
	3. Be able to differentiate between the terms ‘Stroke’ and ‘Transient ischaemic attack’
	4. List different causes of strokes and understand their pathophysiology
	5. List risk factors for cerebrovascular accidents (CVA)
	6. Outline the pattern of venous drainage of the brain.
	7. Explain the difference between a subdural and a extradural haemorrhage

**Session 7: Spinal cord and neuromuscular control of movements & Vestibular apparatus and pathways**

* 1. Describe the structure and function of the  neuromuscular junction (NMJ)
	2. Describe structure and organisation of alpha motoneurones and the motor unit
	3. Distinguish properties of different motor unit types.
	4. Understand concept of trophism
	5. Describe functional organisation of the spinal cord
	6. Describe a range of spinal reflexes (stretch reflex, flexion or withdrawal reflex,

 crossed extension reflex).

* 1. Describe a Distinguish hypo & hyper-reflexia
	2. Understand the concept of supraspinal control of reflexes

**Peripheral nerve motor conduction velocity in man**

* 1. To understand the procedures by which nerve conduction velocity can be measured and its clinical relevance
	2. To understand the factors that affects the measurement of nerve conduction velocity.

**Vestibular apparatus and pathways**

Learning objectives

* 1. Draw a diagram of the vestibular apparatus and label the main components
	2. Describe the transduction functions of the sensory organs of the labyrinth (otoliths and semicircular canals).
	3. Understand what the vestibular signals control – eye movements, balance, autonomic function, perception of motion in space.
	4. Describe the basic pathways from the vestibular apparatus through the brain stem.
	5. Describe the procedures and rationale for routine tests of vestibular function.
	6. Outline the main disorders of the vestibular system

**Session 8: Sensory system. spinal cord lesions/ Pain and headaches**

**Tutorial: Case histories: Sensory system/spinal cord lesions**

* 1. Understand the structure of the spinal cord and its different sensory tracts
	2. Recognise the patterns of pathology relating to different cord lesions
	3. Know the dermatome distribution of the body

**Pain/Headaches**

* 1. To understand the neurovascular anatomy underlying primary headache disorders.
	2. To understand the concept and clinical relevance of cortical spreading depression.
	3. To appreciate the importance of dopamine, serotonin and CRGP in migraine pathogenesis and treatment.
	4. To understand the clinical manifestations of common and important primary headache disorders (migraine, tension-type headache, cluster headache and other trigeminal autonomic cephalgias).

**Session 9: Basal ganglia and cerebellum & Structure and function of the eye**

**Basal Ganglia and cerebellum**

* 1. Locate the basal ganglia structures and know how they interact Know the clinical signs of Parkinson's disease (PD) and Huntington's disease (HD).
	2. Parkinson’s disease: Know which structures degenerate and the clinical signs Explain how the cerebellum contributes to coordination of movement.
	3. Huntington’s disease: Know which structures degenerate and the clinical signs
	4. Cerebellum: Anatomy / Functional Anatomy and clinical correspondence of dysfunction
	5. Clinical signs of cerebellar disorders

**Overview of the visual system: Structure and function of the eye**

* 1. To understand the principle anatomic features of the component structures of the eye, and their associated pathology.
	2. To understand how the human retina is specialized for spatial vision (visual acuity) and how this attribute of vision is measured clinically.
	3. To understand the retinal basis of human colour vision and associated congenital colour vision abnormalities.

**Session 10: Sound conduction and transduction and auditory pathways/ Somatosensory system: pathways, sensory loss, 2 point discrimination/ Nociception**

**Sound conduction and transduction and auditory pathways**

* 1. Explain the relation between frequency/ pitch  and intensity/loudness of  a sound
	2. Describe in outline the structure of the ear
	3. Explain the mechanisms for amplification and safety in the middle ear
	4. Label simple diagrams of the cochlea to show the compartments, membranes and organ of Corti.
	5. Explain the steps by which movements of stapes brings about depolarisation of hair cells.
	6. Explain how the mechanical properties of the basilar membrane and the hair cells result in frequency analysis of sound waves by the cochlea.
	7. Distinguish between outer and inner hair cells.
	8. Label a diagram of the main structures and tracts forming the central projections of the auditory nerve.
	9. Define tonotopic mapping.
	10. Identify the part of the auditory pathway involved in auditory reflexes.
	11. List the main causes of conductive and sensorineural deafness.

**Somatosensory systems**

* 1. List the major somatosensory modalities.
	2. Define proprioception and list the main types of receptor.
	3. Explain the terms: receptor, stimulus threshold and intensity, adaptation, receptive field and lateral inhibition as applied to sensory systems.
	4. Describe the pathway serving touch/proprioception for information from the body and face.
	5. Explain the somatotopic organisation of the touch pathway and sensory cortex.
	6. Outline the main circumstances in which somatosensory deficits may occur

**Nociception**

* 1. Describe how nociceptive receptors differ from those for touch and proprioception.
	2. Understand the pathways by which nociceptive information is transmitted to 'higher centres'.
	3. Describe the parts of the brain which process nociceptive information.
	4. Describe how nociceptive input can be gated by peripheral and central mechanisms.

**Session 11***:* Peripheral Nervous System (PNS)/ **Visual system: pathways and function/ Dementias**

**Peripheral nervous system (PNS)**

* 1. To understand the structure and function of a peripheral nerve and appreciate the main causes and clinical effects of nerve dysfunction
	2. Describe the structural and functional components of a peripheral nerve.
	3. State the spinal levels which contribute to the nerves of the upper and lower limb.
	4. Define a dermatome and explain how it can contribute to clinical diagnosis.
	5. Understand the anatomical and physiological basis of techniques used to study nerve function and dysfunction.
	6. Contrast the consequences of nerve section, nerve compression (e.g. carpal tunnel syndrome) and peripheral neuropathies.

**Visual system: pathways and function**

* 1. Know anatomy of visual pathways
	2. Introduce level of visual processing at each part of pathway
	3. Appreciate visual dysfunction associated with different sites of neuro-anatomical damage and different pathological processes (Optic Nerves, Chiasm, Tracts, Radiations, Visual Cortex, ’Higher’ Visual Areas)

**Dementias**

* 1. What is meant by dementia
	2. How different types of dementia can present
	3. How the pathologies differ
	4. The current cost to society
	5. Treatment options and future directions

**Session 12: Physiology of eye movements and common eye movement disorders/ Neuroinflammation of the CNS**

**The organisation of the eye movements and common abnormalities**

* 1. Describe the movements of the eye with respect to the actions of the extra ocular muscles
	2. Describe the main functional eye movements saccades, pursuit, vestibular ocular reflexes, optokinetic reflex, vergence.
	3. Describe the main types of normal  and pathological nystagmus: vestibular, optokinetic,  gaze paretic, congenital, and give a simple explanation of their origin.
	4. Describe the main brainstem pathways for vertical and horizontal eye movement.
	5. Understand the internuclear pathways for horizontal gaze.
	6. Understand the main disorders of saccadic eye movements.

**Neuroinflammation of the CNS**

* 1. Understand the clinical presentation, pathophysiology and diagnosis of:

Multiple sclerosis

Other CNS-specific inflammatory syndromes

Acute disseminated encephalomyelitis

Neuromyelitis optica

**Session 13: Clinical perspectives on sleep/ Pathophysiology of headaches**

**Clinical perspective on sleep/ Level and content of consciousness**

* 1. Know the brain structures and neurotransmitter systems involved in the regulation of sleep and waking.
	2. Describe the EEG features of different states of awareness.
	3. Describe the stages of sleep, including their behavioural and ‘consciousness’ aspects.
	4. Have an overview of sleep disorders and what we know about their aetiology.
	5. Understand how drugs impact on the sleep-wake process.

**Pathophysiology of headaches**

* 1. Anatomy and function of cephalic pain pathways ( neuroimaging & animal studies)
	2. Molecular pharmacology of cephalic pain
	3. Migraine aura
	4. Synthesis of mechanisms potentially involved in migraine and cephalic pain into one cascade

**Session 14: EEG/Epilepsy**

* 1. Understand the use of EEG recording in the diagnosis of epilepsy.
	2. Have an overview of different types of seizure.
	3. Understand possible causes of epilepsy and their treatment.

**Session 15: Cerebral cortical functions/disorders of cognition/ Language**

**Cortical functions/disorders of cognition and Language**

* 1. Learn the cortical areas and circuits involved in cognitive functions
	2. Understand some of the mechanisms that underlie disorders of cognition
	3. Describe the areas of the brain involved in language processing
	4. Understand the definition of dementia and list possible causes of dementia

### Psychology

**Module Leader:** Dr David Murphy

**Psychology Module**

**Learning Theory**

1. Explain learning theory
2. Understand and be able to explain Classical Conditioning
3. Understand and be able to explain Operant Conditioning
4. Differentiate between positive reinforcement, negative reinforcement and punishment.
5. Define and describe the various schedules of reinforcement.
6. Define observational learning, describe Bandura’s modeling theory, and outline the steps in the modeling process.
7. Understand and explain approaches to increasing the likelihood of desirable behaviours and decreasing the likelihood of undesirable behaviours

**Health Behaviour**

1. Discuss the role of behavioural factors in the aetiology of major diseases
2. Define health behaviour
3. Describe the role of health education in disease prevention
4. Discuss the role of learning and habit in health behaviour
5. Discuss the role of attitudes and beliefs in health behaviour
6. Understand the influence of social environment on health behaviours
7. Define “self efficacy” and the factors which influence it
8. Outline the Health Beliefs Model and the Theory of Planned Behaviour
9. Describe effective approaches to modifying health behaviour

**Individual Differences**

1. Outline psychodynamic theory of personality development.
2. Describe the ‘Big Five’ trait model of personality
3. Explain how psychometric testing is used in personality measurement
4. Describe Spearman’s g factor of intelligence and cite evidence that supports it.
5. Differentiate between crystallised and fluid intelligence and explain how they are affected by aging.
6. Explain how psychometric tests help differentiate between normal changes in cognition through aging and those caused by disease
7. Define IQ and explain why it is not always a useful concept to describe an individual’s abilities.
8. Describe the findings of twin studies on the roles of heredity and environment in intelligence research
9. Define Simon Baron-Cohen’s Systemising and Empathising Quotients and how they relate to autism.

**Attention & Perception**

1. Differentiate between sensation and perception.
2. Contrast bottom-up and top-down processing of sensory information.
3. Define Attention and contrast focussed (selective) and divided attention
4. Describe the biological development of perceptual skills, and explain how they are affected by cross-cultural factors, critical periods, and experience.
5. Outline the stages in Humphreys & Riddoch’s hierarchical model of object recognition
6. Define Apperceptive and Associative Visual Agnosia

**Perception of physical symptoms**

1. Explain the limitations of a uni-dimensional model of pain.
2. Outline the Gate Theory of Pain and explain the mechanisms through which the psychological factors influence the experience of pain.
3. Discuss the lack of concordance of physiological parameters and symptom perception.
4. Discuss the role of attention in symptom perception (esp pain).
5. Describe the role of anxiety and mood in symptom perception.
6. Describe the role of culture and social environment in symptom perception and illness behaviour.
7. Define the different methods of measuring pain
8. Define the placebo effect and possible mechanisms of action.
9. Explain the differences between acute and chronic pain

**Memory & cognitive aspects of mental health disorders**

1. Define memory and the processes of registration, encoding, storage and retrieval
2. Describe the components of working memory
3. Describe the different types of long-term memory
4. Differentiate between effortful and automatic processing
5. Define schema and explain how schemas enhance encoding and influence memory construction
6. Define an associative network
7. Outline the role of cognitive factors in depression

**Adherence to treatment regimes**

1. To define the terms “adherence” and “compliance” and describe the limitations of these terms.
2. To develop an understanding of the scale of non-adherence to health care advice
3. To describe the clinical and economic consequences of non-adherence
4. To identify the main causes of non-adherence
5. To describe the role of failure to understand and recall in non-adherence
6. To describe ways of improving recall of health care information and enhancing adherence to advice

**Coping with Illness and Disability**

1. Describe Kubler-Ross’s Stage Theory model of adjustment to dying and Shontz’s (1975) stage theory model of adjustment to diagnosis.
2. Discuss the evidence for the existence of discrete universal stages of adjustment and give examples of some limitations of stage theories.
3. Outline the Crisis theory of adjustment, give examples of illness and background factors affecting adjustment and describe the role of appraisal.
4. Define Leventhal’s five dimensions of illness representations.
5. Describe how illness representations can influence recovery after illness or injury
6. Cite evidence that demonstrates how psychological factors can affect outcome in long-term health conditions
7. Give examples of how psychological interventions can improve coping behaviours and emotional adjustment to illness and disability

**Developmental Psychology**

1. To consider the relative influences of heredity and environment in human development
2. To describe what and how babies contribute to their own development and the process of reciprocal socialization
3. To describe how parents provide a supportive environment for development
4. To define attachment and describe how disruptions in attachment affect psychological development
5. To describe Piaget’s theory of changes in cognitive during childhood
6. To describe cognitive, emotional and relationship changes during adolescence

**Coping with treatment**

1. Describe with reference to Lazarus & Folkman’s Transactional definition of stress why some medical and surgical procedures are stressful.
2. Identify strategies to prepare patients for treatment
3. Describe the two different types of information which can be provided and their relative efficacy in reducing distress.
4. Describe the effect of perceived control on patient distress
5. Define and give examples of problem-focussed and emotion-focussed coping strategies.
6. Discuss the importance of identify individual differences in preferred coping style and the importance of matching preparation to patient preferred coping style.
7. Describe the specific considerations for helping children cope with treatment.
8. Give examples of effective strategies to help children cope with treatment

**Social Psychology**

1. Define Attitudes and discuss the relationship between attitudes and behaviour
2. Define prejudice and describe how prejudice is maintained
3. Define conformity and discuss the factors predicting conformity
4. Define Group Processes of Social Loafing, De-individuation, Group Polarization and Group Think.
5. Discuss the factors which predict helping behaviour including the “bystander effect”
6. Define “Leadership” and styles of leadership
7. Discuss the characteristics of effective leadership

**Clinical Decision Making**

1. Describe why people are generally very poor at making probability judgments
2. Contrast ‘hot’ and ‘cold’ systems of thinking
3. Define the most common types of error made in decision making.
4. Describe how these errors can affect health-related decisions by both patients and doctors
5. Describe “Anchoring” and the ‘Framing Effect’.
6. Define the “availability”’ and “representativeness” heuristics
7. Describe methods to improve clinical decision making.
8. Define “algorithms” and discuss their potential benefits and limitations in clinical situations

### Pharmacology

**Module Leader:** Dr Chris John & Dr Mike Schachter

#### Learning Outcomes

**Autumn Term**

**Lecture 1 & 2 (Dr M. Croucher)**

* + - 1. To review and consolidate the essential principles of pharmacodynamics and quantitative pharmacology with which all students should be familiar at this stage of the course, thereby establishing a sound understanding and working knowledge of the essential principles of pharmacology on which the teaching of the Pharmacology and Therapeutics Course will be based.

**Lectures 3 & 5 (Prof N. Gooderham)**

* + - 1. To understand the general principles of xenobiotic (foreign chemical) biotransformation.
			2. Be able to describe the routes and biochemistry of Phase 1 metabolism.
			3. Be able to describe the routes and biochemistry of Phase 2 metabolism.
			4. To understand the importance of drug metabolism in pharmacology.

**Lecture 4 (Dr C. John)**

* + - 1. Identify (a) the principal efferent paths of communication between the CNS and the periphery, (b) the two main branches of the autonomic nervous system (ANS) and (c) the enteric nervous system.
			2. Identify the principal target organs of (a) the sympathetic nervous system and (b) the parasympathetic nervous system and describe how each responds to autonomic stimulation.
			3. Draw a schematic diagram illustrating the general organisation of the sympathetic and parasympathetic nervous systems and explain how it differs from that of the somatic nervous system.
			4. Identify the transmitters released from pre- and post-ganglionic fibres in the sympathetic and parasympathetic nervous systems; note that (a) acetylcholine is also used as a transmitter in the somatic nervous system and in the brain and (b) noradrenaline and adrenaline are also transmitters in the brain.
			5. Describe the processes involved in the biosynthesis, release and metabolism of acetylcholine and identify potential targets for pharmacological manipulation of cholinergic transmission.
			6. Describe the processes involved in the biosynthesis, release and metabolism of noradrenaline (norepinephrine) and adrenaline (epinephrine) and identify potential targets for pharmacological manipulation of adrenergic transmission.
			7. Classify the cholinoceptors located in the ANS into two main classes and state (a) where each type is found and (b) the signalling systems they each employ.

**Lecture 6 (Dr M. Croucher)**

* + - 1. Classify the cholinoceptors located in the ANS into two main classes and state (a) where each type is found and (b) the signalling systems they each employ.
			2. Note that nicotinic cholinoceptors are also found in the somatic nervous system but these receptors differ pharmacologically from the nicotinic receptors found in the autonomic nervous system.
			3. Explain how (a) directly acting and (b) indirectly acting cholinomimetic drugs produce their biological actions and state why the former are more selective in their actions.
			4. Describe the pharmacological responses to systemic administration of a muscarinic receptor agonist.
			5. Note that there are three subtypes of muscarinic cholinoceptor and receptor subtype selective compounds are increasingly becoming available.
			6. Explain why choline-esters such as bethanechol have a longer duration of action than acetylcholine.
			7. Explain why pilocarpine is useful in the treatment of glaucoma. State the main pharmacokinetic properties and unwanted effects of this drug.
			8. Describe the distribution and substrate specificity of acetylcholinesterase and butyrylcholinesterase.
			9. Classify the anticholinesterase drugs and explain their modes of action.
			10. Describe the effects of anticholinesterase drugs on transmission in the autonomic nervous system, and note that these drugs also have effects at the neuromuscular junction and in the central nervous system. What are the functional consequences of cholinesterase blockade?
			11. Describe the clinical uses and pharmacokinetic properties of physostigmine, neostigmine and ecothiopate.
			12. Describe the signs and symptoms of anticholinesterase poisoning and state how they may be treated.

**Lecture 7 (Dr G. Gillies)**

*Directly acting sympathomimetics*

* + - 1. Revise the general structure of the sympathetic nervous system.
			2. Describe the distribution of the adrenoceptor subtypes within the tissues of the body and the physiological consequences of activation of these receptors.
			3. Name the endogenous substances which activate these receptors and explain what is meant by adrenoceptor selectivity.
			4. Give examples of drugs that selectively and non-selectively activate α and β adrenoceptors.
			5. List the uses, principal pharmacological features, mechanism of action and unwanted effects of these drugs.

*Drugs acting on adrenergic neurones (excluding ganglion blockers)*

* + - 1. Explain why foods which contain tyramine, an indirectly acting sympathomimetic, represent no harm to the normal subject, but may precipitate a life-threatening hypertensive crises in patients taking monoamine oxidase inhibitors.

**Lecture 8 (Dr M. Schachter)**

* + - 1. To appreciate the extent of the clinical applications of inhibitors of muscarinic receptors in the parasympathetic nervous system: review sites of action throughout the body.
			2. To focus on three specific therapeutic areas:
* the use of muscarinic antagonists in regulating heart rate
* the use of muscarinic antagonists in modifying bronchial smooth muscle tone
* the use of muscarinic antagonists in regulating bladder function.
	+ - 1. To be aware of specific examples of the drugs used in each of these situations, with basic information on their routes of administration and the way they are handled in the body (ie pharmacokinetics, reminder of basic concepts).
			2. To briefly review other clinical uses of peripheral antimuscarinic drugs
			3. To appreciate the possible adverse effects of these drugs and their clinical significance
			4. To understand the concept of balance between sympathetic and parasympathetic “tone”.
			5. To be aware of the therapeutic relevance of blocking central muscarinic receptors.

**Lecture 9 (Dr C. John)**

* + - 1. Describe the consequences of ganglion blockade.
			2. Describe the consequences of muscarinic cholinoceptor blockade, using atropine as an example.
			3. List the principal pharmacokinetic properties of atropine and hyoscine.
			4. List the main clinical uses and unwanted effects of muscarinic cholinoceptor antagonists.
			5. Describe the signs and symptoms of atropine poisoning and state how they may be treated.

**Lecture 10 (Dr D. Dexter)**

* + - 1. Name common examples of non-selective and selective SNS antagonists and what are they clinically used for.
			2. How do SNS antagonists produce their anti-hypertensive effects and what are their side effects?
			3. Compare the effects produced by selective and non-selective antagonists, name examples of each drug.
			4. What other beneficial effects does Prazosin have which is increasing its popularity as an anti-hypertensive?
			5. Describe the actions of the false transmitter methyldopa and what are its clinical uses and side effects.
			6. How can SNS antagonist drugs be used to treat arrhthymias and angina?
			7. What is glaucoma and how is the aqueous humor formed in the eye?
			8. Describe how SNS agonists and antagonists can be used in the treatment of glaucoma. What other drugs can be used to treat glaucoma and by what mechanisms do they work?

**Lecture 11 (Dr M. Croucher)**

* + - 1. **What is the neurotransmitter at the skeletal neuromuscular junction and on which receptor type does it act?**
			2. Define the nature of the antagonism of tubocurarine on the effects of acetylcholine (ACh) at the motor end-plate.
			3. Draw a log dose-response curve showing the response of skeletal muscle to increasing concentrations of ACh. How would the shape of this curve be altered in the presence of tubocurarine?
			4. Why is tubocurarine not effective if given orally and why does it not act centrally?
			5. By what route is tubocurarine administered, what is its duration of action, and how is it eliminated from the body?
			6. Why are tubocurarine-like drugs used in surgery and how may their actions be reversed?
			7. The major unwanted effects of tubocurarine include a reduction in blood pressure, bronchospasm, tachycardia and apnoea. Explain how these effects arise.

**Tutorial 1 (Tutors)**

* As above

**Practical 1 (Dr C. John)**

* + - 1. To illustrate the effect of anticholinergic and cholinergic agents on the human eye.
			2. To discuss various other principles relevant to ocular pharmacology.

**Practical 2 (Dr S Smith & Dr M. Croucher)**

* + - 1. Describe the actions of β-adrenoceptor agonists on the cardiovascular and respiratory systems.
			2. Summarise and explain the effects of β-adrenoceptor antagonists on tachycardia, hypertension and cardiac arrhythmia.
			3. Identify two groups of patients who should not be treated with β-adrenoceptor antagonists.

**Spring Term**

**Clinical Applications of Drugs Acting on the PNS**

Dr Mike Schachter

* + - 1. To appreciate the extent of the clinical applications of inhibitors of muscarinic receptors in the parasympathetic nervous system: review sites of action throughout the body.
			2. To focus on three specific therapeutic areas:
1. the use of muscarinic antagonists in regulating heart rate
2. the use of muscarinic antagonists in modifying bronchial smooth muscle tone
3. the use of muscarinic antagonists in regulating bladder function.
	* + 1. To be aware of specific examples of the drugs used in each of these situations, with basic information on their routes of administration and the way they are handled in the body (ie pharmacokinetics, reminder of basic concepts).
			2. To briefly review other clinical uses of peripheral antimuscarinic drugs
			3. To appreciate the possible adverse effects of these drugs and their clinical significance
			4. To understand the concept of balance between sympathetic and parasympathetic “tone”.
			5. To be aware of the therapeutic relevance of blocking central muscarinic receptors

**Drugs and heart**

Professor Alun Hughes

* + - 1. To be able to describe the mechanisms regulating heart rate and contractility that are therapeutic targets in the heart
			2. To be able to describe the determinants of myocardial oxygen supply and demand and how these are favourably influenced by
	+ Beta blockers
	+ Organic nitrates and potassium channel openers
	+ Calcium antagonists
1. To know the major adverse effects of:
	1. Beta blockers
	2. Organic nitrates and potassium channel openers
	3. Calcium antagonists
2. To know the basis of the Vaughan Williams classification and understand its limitations
3. Know the major uses of and be able to describe the mechanisms of action of:
	1. Adenosine
	2. Verapamil
	3. Amiodarone
	4. Digoxin and cardiac glycosides
4. To be able to describe the mechanisms of action of cardiac inotropes and their clinical uses

**Drugs and the vasculature**

Professor Alun Hughes

1. To be able to describe the mechanisms regulating vascular tone and peripheral vascular resistance.
2. To be able to describe how the various inhibitors of the renin angiotensin aldosterone system act (i.e. angiotensin converting enzyme inhibitors, angiotensin (AT1) receptor antagonists, aldosterone antagonists) and know the major indications for their use and their major adverse effects
3. To be able to describe how calcium channel antagonists cause vasodilation and know the major indications for their use and their major adverse effects
4. To be able to describe how inhibitors of the sympathetic nervous system act and know the major indications for their use and their major adverse effects
5. To be able to describe the mechanism of action of sumitriptan, why it is used in migraine and its major adverse effects
6. To be able to explain the principles underlying the treatment of hypertension and heart failure.

**Haemostasis and Thrombosis**

(Dr Sohag Saleh)

1. To understand the terms haemostasis and thrombosis and differentiate between them
2. To understand the process of coagulation and the actions of drugs that affect production or activation of clotting factors
3. To understand the process of platelet activation and the action of specific antiplatelet drugs
4. To understand the actions of fibrin and the role of thrombolytic drugs
5. To understand which of these classes of drugs can be used in specific clinical situations.

**Atherosclerosis and lipid metabolism**

Dr Mike Schachter

1. To understand current concepts of the pathogenesis of atherosclerosis
2. To focus on the role of lipids, particularly cholesterol, in the development of atherosclerosis
3. To introduce the idea of lipid lowering therapies in the prevention and treatment of atherosclerotic vascular disease.

**Adverse Drug Reactions and Interactions – Thursday 26th January (a.m.)**

Mike Schachter

1. To appreciate the clinical significance of adverse drug reactions (ADRs)
2. To understand the ways in which ADRs can be categorised and why this is of practical relevance in prescribing
3. To understand nature of drug interactions, especially if these lead to important ADRs

**Diuretics**

Dr Chris John

1. Revise the physiology of the kidney, focusing on the mechanisms which regulate the ionic composition (particularly Na+, Cl- and K+), volume and osmolarity of the urine.
2. Explain how the following groups of diuretic drugs alfter the ionic composition, volume and osmolarity of the urine
* osmotic diuretics, e.g. mannitol
* carbonic anhydrase inhibitors, e.g. acetazolamide
* loop diuretics, e.g. furosemide (frusemide)
* thiazides, e.g. bendroflumethiaze (bendrofluazide)
* potassium sparing diuretics. e.g. amiloride, spironolactone.
1. Note that loop diuretics, thiazides and K+ sparing diuretics are clinically the most important groups of diuretics.
2. For each of the following drugs (a) name the principal conditions for which they are used clinically, (b) list their main pharmocokinetic properties and (c) describe and explain where possible their principal adverse effects.

**(i)** frusemide

**(ii)** bendrofluazide

**(iii)** amiloride

1. Spironolactone

**Anti-emetics**

Dr Glenda Gillies

1. To describe, in broad terms, the control of vomiting (see Fig.)
2. To state the receptor specificity, the main sites of action and the specific antiemetic uses of promethazine, metoclopramide, hyoscine and ondansetreon (see Fig.).
3. To list the main pharmacokinetic features and unwanted actions of specific drugs.

**Treatment of gastric and duodenal ulcers**

Dr Glenda Gillies

100. Describe the factors that impinge on the development of peptic ulcer disease.

101. Explain why antibiotics feature prominently in the treatment of peptic ulcer disease.

102. Using named examples, explain, with the use of a clearly labelled diagram, the mechanisms by which proton pump inhibitors and histamine (H2) receptor antagonists promote the healing of gastric ulcers

103. Explain why misoprostol may be used in the treatment of iatrogenic peptic ulcer disease.

104. Describe the mechanisms by which sucralphate and bismuth chelate are thought to be useful anti-ulcer drugs.

105. Provide two examples of ‘triple therapy’ for peptic ulcer disease.

106. What do you understand by the term ‘gastroesophageal reflux disease’ and how may it be treated?

**Non-Steroidal Anti-inflammatory Drugs (NSAIDs)**

Dr SF Smith:

1. Give examples of at least three conditions for which NSAIDs are used clinically.
2. Describe the underlying mechanism of action by which all NSAIDs have their therapeutic effects.
3. Explain how this mechanism produces the analgesic, anti-inflammatory and antipyretic effects of NSAIDs.
4. List the most important side effects of NSAIDS, explain why these occur and what attempts have been made to minimise them.
5. Explain why selective COX-2 inhibitors have proved less successful than hoped
6. Explain why paracetamol is not a NSAID.
7. Identify the key difference between the mechanism of action of aspirin and other NSAIDs and explain how this difference can be harnessed clinically.

#### Variability in the human response to drugs tutorial

Dr M Schachter m.schachter@imperial.ac.uk

Dr SF Smith sue.smith@imperial.ac.uk

1. To understand causes of variations in response to any specific drug between individuals or within an individual at different times in terms of:
2. Differences in the concentrations of drug reaching the tissues (ie factors affecting absorption, distribution, metabolism and excretion of the drug)
3. Differences in response of the target tissues to the same degree of stimulation (ie factors such as variation in receptor sensitivity, number and distribution). These reasons are mainly, but not exclusively, genetic and are considered in detail elsewhere in this course.
4. Both the desired and unwanted responses to any given drug may vary between individuals. The reasons for this can be subdivided into:

**Inflammatory Bowel Disease**

Dr Sue Smith

1. List the major forms of inflammatory bowel disease (IBD) and explain how they differ in terms of pathology and responsiveness to treatment.
2. List the three major classes of drug used to treat the symptoms of these disorders and name one example of each.
3. Describe a proposed mechanism of action for each class of drug.
4. Describe the main beneficial effects and side-effects of each named drug and its key pharmacokinetic features.
5. Describe the strategies used to minimise the side-effects of each named drug.
6. Summarise the advantages and disadvantages of biologic (monoclonal antibody) treatments for IBD administered alone and in combination with immunomodulators.

**Drugs of abuse 1 & 2**

Dr Chris John

1. Describe the ‘reward’ pathways in the brain activated by drugs of abuse. Which are the main abused substances and how do they specifically activate reward pathways?
2. Describe the pharmacokinetics for the major drugs of abuse (e.g. routes of administration, metabolism).
3. Describe the basic pharmacology for the main abused substances.

**Alcohol**

Dr Chris John

127. Describe the dose-dependent effects of acute ethanol ingestion on

(a) CNS function and put forward theories to explain the underlying mechanism of action

(b) Other body systems

128. Describe the consequences of long-term excessive ethanol consumption

129. Outline the main pharmacokinetic features of ethanol

130. Explain how tolerance to the effects of ethanol is produced. What symptoms are associated with alcohol withdrawal in dependent subjects?

**Anti-Parkinsonian drugs and Neuroleptics**

Dr David T Dexter

1. Describe the synthetic and metabolic pathways of the neurotransmitter dopamine.
2. What are the three main dopaminergic pathways in the brain and what are their basic functions.
3. What are the two main sub-groups of dopamine receptors.
4. Describe the main clinical features of Parkinson’s disease.
5. Which age group of the population is affected by Parkinson’s disease.
6. What are the main pathological and biochemical features of Parkinson’s disease.
7. Do the symptoms of Parkinson’s disease appear immediately.
8. Can dopamine itself cross the blood brain barrier.
9. In standard preparations what drug is combined with L-DOPA to prevent peripheral side effects.
10. What are the short and long-term side effects of L-DOPA therapy and how common are such side effects experienced.
11. In the treatment of Parkinson’s disease how does the mechanism of action of bromocriptine differ from that of L-DOPA.
12. By what mechanism can Deprenyl be utilised to reduce the dosage of L-DOPA required.
13. How do the COMT inhibitors and the MAO inhibitors differ in their mechanism of action.
14. Describe the clinical symptoms of schizophrenia. Which age group are most likely to be affected.
15. What is the principle neurotransmitter defect in schizophrenia.
16. Are neuroleptic drugs selective for dopamine receptors.
17. Apart from anti-schizophrenic actions, what are other effects produced by neuroleptic drugs that are due to antagonism at dopamine receptors.
18. What are acute and tardive dyskinesias and when do they occur in the treatment of schizophrenia.
19. What are the other unwanted side-effects of neuroleptics that are unrelated to their blockade of dopamine receptors

**Opioids**

Dr Chris John

1. Define the terms opiate and opioid; note the importance of opiates and opioids in the clinical control of severe pain.
2. List the principal subtypes of opioid receptor and identify their endogenous ligands
3. Outline the signalling mechanisms used by opioid receptors and note the availability of pure agonists, weak agonists, partial agonists, mixed agonist/antagonists and antagonists
4. Draw a simple diagram showing the main central nervous pathways concerned with pain transmission/perception. Identify sites within these pathways where opiates/opioids modify transmission.
5. Describe and explain how opiates influence other physiological functions (e.g. respiration) and state which of these actions may be advantageous clinically and which may cause unwanted effects.
6. Note that opiates/opioids may produce tolerance and dependence.
7. Describe the main pharmacokinetic characteristics of morphine
8. Explain how the following drugs differ from morphine in their pharmacodynamic and pharmacokinetic properties and how these differences influence their clinical usage
* Heroin (diamorphine)
* Codeine
* Pethidine
* Methadone
* Fantanyl
1. Describe the clinical use of opioid receptor antagonists
2. Describe the main characteristics of opioid withdrawal in opioid-dependent subjects.

**Principles of GABAergic transmission**

**Anxiolytics, sedatives and hypnotics**

Dr Martin Croucher

160. Which are the principal inhibitory and excitatory amino acid neurotransmitters in the mammalian CNS? With which types of neurons are these transmitters associated?

**161.** Briefly describe the processes involved in GABAergic synaptic transmission. How may this knowledge be useful in the design of novel therapeutically useful drugs?

162. Compare and contrast the principal characteristics of GABA-A and GABA-B receptors.

163. List the principal clinical uses (with routes of administration) of the benzodiazepines and the barbiturates.

164. What are the main undesirable effects of the benzodiazepines? How do these compare with the unwanted effects of the barbiturates?

165. Do individual benzodiazepines differ in terms of

* their mechanisms,
* their profiles,
* their durations of action?

166. How do differences in durations of action influence the therapeutic usefulness of these compounds?

Give examples.

167. Define the term ‘anxiolytic drug’. State three **classes** of drugs which have useful anxiolytic properties.

168. Name three drugs widely used for their hypnotic effects. Why is diazepam not used in this capacity*?*

**Principles of General Anaesthesia**

Dr Chris John

1. Explain the clinical objectives of general anaesthesia
2. Describe the pharmacology of inhalational anaesthetics and be able to list examples.
3. Describe the pharmacology of intravenous anaesthetic drugs and be able to name examples.
4. What are the potential neuroanatomical sites of general anaesthetic action?
5. What other drugs are used clinically to facilitate anaesthesia? Why are they used?

## Principles of local anaesthesia

Dr. Martin Croucher

1. Revise the properties of electrically excitable cells that underlie the generation of neuronal action potentials.
2. Note the general chemical structures of local anaesthetics (LAs) and the two main classes into which they can be divided. Name **one** drug from each class.
3. Describe the principal cellular mechanism of action of LAs. How does this give rise to the property of ‘use-dependency’ of these agents?
4. Identify the effects of LAs on i) AP generation and propagation and ii) resting membrane potential. How and why do these effects differ in infected tissue compared to healthy tissue?
5. Outline the **six** main routes of administration of LAs, including their clinical usefulness. Why are vasoconstrictor substances often co-administered with LAs?
6. Describe the pharmacokinetic properties of i) lidocaine and ii) cocaine, indicating how their respective routes of metabolism influence their plasma half lives.
7. List and compare the major unwanted effects of lidocaine and cocaine on i) the CNS and ii) the CVS.

**Cytotoxic drugs**

Dr Sohag Saleh

1. To be able to define the term 'cancer'
2. To be able to describe the characteristics of cancer cells.
3. To be familiar with the molecular basis of chemotherapy
4. To be able to discuss the potential targets for chemotherapy.
5. To be able to identify the major classes of anticancer drugs and describe their mechanisms of action.

**Antimicrobial drugs 1 and 2**

Dr Sohag Saleh

1. Understand the meaning of selective toxicity. How do human cells differ from microbes that offer us drug targets?
2. What are the main classes of antibiotic drugs and how can they be distinguished according to their mechanisms of action.
3. By what mechanisms are bacteria and other microbes becoming resistant to drugs?
4. Understand why tuberculosis is a killer disease again and what are the modern ideas/drugs for the treatment of tuberculosis.
5. Understand the types of fungal infections that can affect us and how can we utilise drugs to specifically target the fungus wih affecting the host?
6. Be aware of the different types of virus, how they use the host cell to replicate and some of the common diseases they can cause.
7. What are the mechanisms of action of antiviral drugs and what are their side effects.

**Anticonvulsants**

Dr Mike Johnson

1. To understand what an epilepsy seizure is
2. To understand what epilepsy is and its causes
3. To appreciate treatment decisions are based on a balance of risk and benefit
4. To understand the pharmacokinetic principles of prescribing, with reference to an at least one important, commonly used AED
5. To understand the genetic associations with AED-related hypersensitivity, and how these are used in clinical practice and why

### Reproductive Physiology

**Module Leaders:** Dr Mark Sullivan

#### Learning Outcomes

1. Understand how the anatomy of the adult reproductive tract is established
2. Explain the regulation of sexual differentiation, and the clinical consequences of dysregulation
3. Understand how the brain and reproductive tract interact to support gametogenesis, fertilization, pregnancy and birth
4. Understand changes in the HPG axis during childhood, puberty, reproductive life and ageing, and the aetiology of clinical disorders
5. Understand the differences between the male and female in meiosis and gametogenesis
6. Describe the cellular and biochemical events that occur during fertilization and preimplantation development
7. Describe how aneuploidy arises during meiosis and early embryo development, and the relative contributions of the male and female
8. Understand the main events and processes of normal pregnancy and birth, including reasons for the gaps in our knowledge
9. Understand the main causes of infertility, and outline possible clinical treatments
10. Consider possible explanations the high incidence of pregnancy loss in the human
11. Understand the main complications of pregnancy and birth, and outline possible clinical interventions

**1 Lecture 1** Sexual differentiation: development of the male and female reproductive tract

 (Ilpo Huhtaniemi)

1. the Jost concept of sexual differentiation
2. origin of somatic and germinal components of the gonad
3. differentiation of the cellular components of the testis
4. differentiation of the cellular components of the ovary
5. differentiation of the urogenital ductal system
6. genes involved in gonadal differentiation into testis and ovary
7. hormones and paracrine factors regulating the differentiation and maturation of the
8. urogenital ductal system

**2 Lecture 2** Basic anatomy of the reproductive tract in the adult human male

 (Layi Oduwale)

1. Structures and functions of the reproductive tract in the human male

**3 Lecture 3** Basic anatomy of the reproductive tract in the adult human female

(Bryony Jones)

1. Structures and functions of the reproductive tract in the human female

**4 Lecture 4** Menstrual cycle

(Mandy Donaldson)

1. Introduction to the HPG axis
2. The menstrual cycle

**5 Lecture 5** HPG axis - childhood/reproductive life/ageing

(Stephen Franks & Mandy Donaldson)

1. To know the hormones of the HPG including: structure, synthesis and function
2. To understand the control mechanisms of these hormones
3. To know their role in human reproduction
4. To be aware of the physiological and anatomical changes of puberty
5. To know the endocrine changes underlying the above
6. To be aware of the role of body fat and leptin in puberty
7. To be aware of delayed and precocious puberty
8. To be aware of disorders of the adult male and female HPG

**7 Lecture 6** Oogenesis and ovulation

(Kate Hardy)

1. the embryological origins of the somatic and germ cells of the ovary
2. the timing and path of migration of germ cells into the ovary
3. the extent of the proliferation of germ cells before and after colonization of the ovary
4. the timing of differentiation of germ cells into oogonia and oocytes (and understanding of the major functional differences between these three cell types), their entry into meiosis, and subsequent arrest
5. the sequence of events during meiosis
6. progression and timing of meiosis in the oocyte (including periods of meiotic arrest), triggers resumption and completion of meiosis
7. relationship between timing of meiosis and follicle development
8. the timing of follicle formation
9. anatomy of the adult ovary
10. structure of the follicle, communication between the oocyte and the surrounding granulosa cells, function of different compartments of the follicle
11. the stages of follicle development
12. the decline in oocyte number and onset of the menopause
13. ovulation and corpus luteum formation

**8 Lecture 7** Spermatogenesis and sperm transport

(Kevin Lindsay)

1. To understand basic testicular anatomy
2. To understand the cell types and their relationships within the testis
3. To understand the development of the human sperm
4. To understand the relationship between the various testicular compartments
5. To understand the temporal and spatial characteristics needed in the testis
6. To understand post-testicular sperm maturation and transport from male to female

**9 Lecture 8** Fertilization and preimplantation development

(Kate Hardy)

1. Stages of preimplantation development
2. The anatomy of the cleavage stage embryo, morula and blastocyst
3. Timing and localization of preimplantation development
4. Cellular changes during first cell cycle
5. Molecular changes during early cleavage (activation of the embryonic genome)
6. Cellular changes during compaction and blastocyst formation
7. Differentiation of first two lineages
8. Developmental arrest during human preimplantation development
9. Genesis of chromosomal abnormalities in human embryos
10. Cell abnormalities during preimplantation development (cytoplasmic fragmentation)

**10 Lecture 9** Genesis of aneuploidy

(Kate Hardy)

1. The incidence of aneuploidy in gametes, preimplantation embryos, during fetal life and at birth.
2. Gamete and chromosome variation in susceptibility, and possible reasons (prolonged meiotic arrest in female, chromosome size)
3. Non-disjunction during meiosis I and II
4. Non-disjunction and anaphase lag during mitosis, and the possible consequences
5. The increase of aneuploidy with age and the possible reasons

**11 Lecture 10** Overview of human pregnancy

(Mark Sullivan)

1. Maternal perspectives
2. Infant perspectives
3. Placental perspectives

**12 Lecture 11** Basic structure and functions of the human placenta

(Mark Sullivan)

1. Key placental structures
2. Key placental functions
3. Development of placenta
4. Blood flow and placenta

**13 Lecture 12** Key stages of embryonic development

(Mark Sullivan)

1. Embryonic disc
2. Gastrulation & axis formation
3. Ectoderm, mesoderm & endoderm
4. Development of main body structures
5. Development and vulnerability

**14 Lecture 13** Normal term labour

(Mark Sullivan)

1. Stages of labour & main events
2. Changes in cervix and myometrium in labour
3. Biochemistry of labour – an inflammatory process
4. Role of fetal membranes in labour

**15 Lecture 14** Preterm labour

(TG Teoh)

1. Multi-factorial causes of preterm labour
2. Cervical length can be a predictor of risk of preterm labour
3. Primary prevention by cervical cerclge
4. Secondary prevention by tocolysis
5. Infective cause / association as cause of preterm labour
6. Fetal fibronectin as screen for risk of preterm labour

**16 Lecture 15** Miscarriage and ectopic pregnancy

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NO LOs

**17 Lecture 16** Placental complications (IUGR and PE)

(Mark Sullivan)

1. Definition of Pre-eclampsia
2. Proposed Aetiology of PET
3. Maternal consequences of poor placentation
4. Definition of Fetal Growth Restriction
5. Difference between FGR, low birthweight and small for gestational age
6. Neonatal consequences of FGR

**18 Lecture 17** Assisted conception – success and failure

(Mausumi Das)

NO LOs

### THEME – Support Systems

### Alimentary System

**Module Leader:** Dr Julian Walters

#### Learning Outcomes

The overall learning objectives of this course are:

* To review the basics and to introduce advanced concepts of the main physiological aspects of the normal alimentary system.
* To outline examples of malfunction within the alimentary system and to recognise some of the pathophysiological processes involved.

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**Specific objectives of each session are as follows: (order of presentation differs from year to year)**

**1 Lecture 1 Introduction: the Burden of GI disease Julian Walters**

* List the names of the organs of the alimentary tract
* Describe symptoms and signs of alimentary tract disease
* List the main diseases of the GI tract and liver
* Be aware of the economic burden of GI and liver diseases

**2 Tutorials: Review of nutrition Gary Frost**

 **Digestion & cell transport Julian Walters**

* To review the principles of nutrition
* To understand the types of nutrients
* To recognise diseases associated with impaired nutrition
* To review the basics of nutrient digestion
* To review cellular mechanisms relevant to intestinal absorption.

**3 Lecture 2 Structure and functional relationships: GI Motility**

 **Andrew Thillainayagam**.

* To understand the passage of food through the GI tract
* To recognise the functions of the different regions of the GI tract
* To link secretion and absorption to different areas
* To appreciate the role of GI motility in digestion
* To be able to describe some of the mechanisms of motility

**4 Lecture 3 Acid secretion Kevin Murphy**

* To understand the role of gastric acid secretion in digestion
* To recognise the mechanisms of gastric acid secretion
* To be able to describe the regulation of acid secretion

**5 Lecture 4 Gastro-oesophageal reflux disease and ulceration**

 **Jonathan Hoare**

* To recognise diseases of the upper GI tract
* To describe some of the pathophysiological processes involved
* To appreciate the role of acid and motility in gastro-oesophageal reflux disease
* To recognise common drugs used in disorders of acid secretion

**7 Lecture 5 Intestinal absorption Julian Walters**

* To consolidate knowledge of the mechanisms of protein and lipid absorption
* To review absorption of electrolytes and water
* To appreciate mechanisms of absorption of certain other nutrients

**8 Lecture 6 Malabsorption Julian Walters**

* To know what problems may result from malabsorption
* To recognise diseases and mechanisms leading to malabsorption
* To be introduced to the presentation, pathology and treatment of coeliac disease

**9 Lecture 7 Pancreatic exocrine function Kevin Murphy**

* To know the different functions of the pancreas
* To recognise the pathways of pancreatic exocrine secretion
* To learn about the hormonal control of pancreatic secretion

**10 Lecture 8 Abdo pain & Pancreatitis Lakshmana Ayaru**

* To be able to list conditions that produce abdominal pain
* To describe some features of the enteric nervous system
* To recognise the symptoms of acute and chronic pancreatitis
* To appreciate the mechanisms that cause pancreatitis
* To be introduced to the therapeutic principles of pancreatic diseases

**11 Lecture 9 GI hormones & Appetite control Kevin Murphy**

* To recognise specific gut hormones and their actions
* To appreciate the coordination of gastrointestinal function by hormone secretion
* To be introduced to mechanisms of appetite control

**12 Lecture 10 Infections of the GI tract Janice Main**

* To know the types of gastrointestinal infections that may occur
* To recognise causes of infective gastroenteritis
* To appreciate the ways to prevent food poisoning
* To learn about *C. difficile*
* To be introduced to parasitic conditions of the GI tract

**13 Lecture 11 Inflammatory bowel diseases Tim Orchard**

* To recognise the types of inflammatory bowel disease (UC and Crohn's)
* To appreciate some of the symptoms produced by IBD
* To learn about pathological processes that may be implicated in IBD
* To recognise drugs used in the treatment of IBD

**14 Lecture 12 Review of intestinal cell development Julian Walters**

* To review the structure of the small and large intestine
* To review the types of cells found in the intestinal mucosa
* To appreciate mechanisms of cell turnover and differentiation

**15 Lecture 13 Genetic & environmental effects on development of colonic neoplasia Horace Williams**

* To know the types of colorectal neoplasia and their presentation
* To recognise the genetic changes occurring in the progression of colorectal neoplasia
* To learn about familial syndromes and their management
* To appreciate some of the environmental factors that influence neoplasia

**16 Lecture 14 Intestinal immune system Jonathan Nolan**

* To be introduced to the concept of the intestine as an immunological organ
* To be able to describe the immunological cells found in the GI tract
* To appreciate innate and adaptive immune mechanisms
* To recognise conditions of normal and abnormal immune response in the GI tract

**17 Lecture 15 Liver structure and function Abi Zabron**

* To understand hepatic structure and blood supply
* To recognise the cellular organisation of the liver
* To be able to describe the key functions of the liver

**18 Lecture 16 Bilirubin, jaundice, bile secretion & cholestasis Shahid Khan**

* To know the metabolic pathways involving bilirubin
* To recognise jaundice
* To be able to describe the types of jaundice
* To learn about the investigation and treatment of diseases producing jaundice
* To know the pathway for bile secretion
* To recognise the components of bile
* To learn about mechanisms of bile secretion
* To be introduced to pathological mechanisms that produce cholestasis

**19 Lecture 17 Liver failure Harry Antoniades**

* To recognise the picture produced by liver failure
* To list the metabolic problems resulting from liver failure
* To know additional conditions causing liver failure
* To be introduced to treatment options

**20 Lecture 18 Pathophysiology of portal hypertension Ameet Dhar**

* To know the blood supply of the liver
* To understand mechanisms leading to portal hypertension
* To recognise the effects of porto-systemic shunting
* To be introduced to pharmacological approaches for portal hypertension

**21 Lecture 19 Mechanisms of liver injury: alcohol Harry Antoniades**

* To appreciate the problems resulting from alcohol
* To be able to describe features of alcoholic liver disease
* To have an understanding of the mechanisms that lead to liver injury

**22 Lecture 20 Mechanisms of liver injury: viral Marco Purbhoo**

* To list viruses that injure the liver and their epidemiological features
* To compare acute and chronic hepatitis
* To have an understanding of the course of hepatitis A, B and C

### Cardiovascular System

**Module Leader:** Dr Petros Nihoyannopoulos

#### Learning Outcomes

**Session 1:**

*a) The normal anatomy of the heart:*

- Understand the anatomy of the heart and its link with the lungs

- Learn the different subsystems within the heart (coronary anatomy, valves, conduction system, innervation of the heart)

*b) Mechanical properties of the heart:*

- List the sequence of events from excitation that bring about contraction then relaxation of a ventricular cell

- State Starling’s Law of the Heart

- Explain the mechanisms underlying Starling’s Law of the Heart

- Use a graph to compare the length-tension relationships for cardiac and skeletal muscle

- Explain the concepts of preload and afterload

**Session 2:** *The function of normal circulation*

- Understand the function of the normal circulation at rest

- Learn the normal relationship between pressure and volume and understand the concept of disease and the failing heart

- Understand the concept of the circulation

- Understand systolic and diastolic blood pressure

**Session 3:** *Anatomy and function of the Heart from Echocardiography*

**-** Understand the basic principles of echocardiography and familiarized with the views and the main intracardiac structures seen. Understand the basics of Doppler

- Understand the basic concept of the cardiovascular system and how it works.

- Understand the concepts of preload and afterload

**Session 4:** *Ischaemic heart disease and Heart Sounds*

Ischaemic heart disease and Heart Sounds

- Understand mechanisms of cell death

- Understand the main cardiac factors, which give rise to chest pain

- Understand myocardial flow-function relationship

- To be able to state the main clinical investigations that help diagnose angina

- Define myocardial ischaemia and its pathophysiology: the ischaemic cascade

- Understand the various diagnostic tests available

- Understand basic concepts of management

- Understand the normal heart sounds and where they are originated from.

- Understand the role of blood pressure and master how to measure it

**Session 5:** *Definition, epidemiology and prognosis, various aetiologies*

- Understand the basic physiology of the failing heart

- Understand diagnosis, clinical assessment and basic investigations in heart failure

- Understand effects of old age

- Understand effect of renal and hepatic impairment

- Be aware of some drug treatment for angina and myocardial infarction and the rationale behind such treatment

**Session 6:***The normal electrocardiogram and Arrhythmias*

- Understand the normal electrocardiogram and the conduction system

- Be able to recognise a normal ECG

- Be able to describe the basic atrial and ventricular arrhythmias

- Understand conduction abnormalities of the heart

**Session 7:** *Integration of Cardiovascular System*

- Describe the mechanical events of the cardiac cycle

- Use a graph to correlate electrocardiographic events and pressure events of the atria, ventricles, aorta and pulmonary artery

- Indicate on the graph the phases of the cardiac cycle and the corresponding pressure changes, valve openings and closures

- Define and state normal values for right and left ventricular end-diastolic volume, end-systolic volume, stroke volume, end-diastolic pressure and peak systolic pressure

- State the origin of the heart sounds

- Provide the mathematical equation for ejection fraction

- Define cardiac output and indicate its determinants

- Construct simple pressure-volume diagrams from the events during the cardiac cycle and annotate these graphs appropriately

**Session 8:** *Atherosclerosis & Risk factors for coronary artery disease*

- Pathogenesis of atherosclerosis

- Understand the changes in the walls of arteries that lead to atherosclerosis

- Understand blood vessel order, function and blood flow

- Understand how atherosclerosis leads to clinical manifestations and its time course

- Understand vascular endothelium

- Understand the formation of the atherosclerotic plaque and plaque rupture

- Understand the various risk factors leading to coronary artery disease

**Session 9:** *Electrical activity of the heart & Valvular Heart Disease*

*a.**Electrical activity of the Heart*

- Understand the action potential

- Understand how electrical activity is transmitted to all parts of the ventricles through the Bundle of His and the Purkinje fibres

- Be able to describe the conventional PQRST nomenclature and state the electrical events that each represents

*b. Valvular heart disease*

- Understand the physiology of the heart valves

- Understand the mitral valve: stenotic and regurgitant lesions

- Understand the aortic valve: stenotic and regurgitant lesions

- Understand the tricuspid and pulmonary valves

- Understand basic concepts of endocarditis

*c. Heart murmurs*

- Understand the origin of the heart sounds in normal and disease.

- Understand the pathophysiology of the cardiac murmurs

**Session 10:** *The normal electrocardiogram and Arrhythmias*

- Understand the normal electrocardiogram and the conduction system

- Be able to recognise a normal ECG

- Be able to describe the basic atrial and ventricular arrhythmias

- Understand conduction abnormalities of the heart

**Session 11:** *Principles of cardiac surgery for heart disease*

- Be aware of the history of cardiac surgery, including by-pass surgery for coronary artery disease

- Be aware of valve surgery and types of valves

- Understand the concept of valve repair

### Dermatology

**Module Leader:** Professor Tony Chu

General Outcomes

1. Explain the concept of the skin as a single organ of the body with its complex intra-relationships with other organ systems of the body.
2. Describe the basic anatomical structure of the skin and the intra-relationships between the epidermis, dermis and subcutis.
3. Describe the structure of the epidermis and associated adnexal structures its foetal development and regulation of growth.
4. Outline the mechanisms by which the integrity of the dermoepidermal junction is maintained and the results of failures of these mechanisms.
5. Describe the migrant cell populations within the epidermis and detail their origins.
6. Describe the structure of the dermis including the vascular and nerve supply to the skin, the development of the dermis, regulation of collagen formation and events that occur in senescence.
7. Describe skin pigmentation, the development, function and control of melanocytes and the principals of immediate and delayed tanning.
8. Describe the development and maturation of acquired melanocytic naevi and the features of carcinogenic change within these lesions.
9. Describe the development of the hair follicle, its anatomy and regulation of growth through life including the effect of sex hormones and age on hair growth.
10. Describe the principles of barrier function of the skin and its role in controlling percutaneous water loss and absorption and defence against microbial invasion.
11. Explain the control of body temperature and the role of the cutaneous vasculature in maintaining body temperature.
12. Explain the importance of the skin as an immunological organ and describe the role of individual cell types in the cutaneous immune system.
13. Explain the mechanism of skin wound healing
14. Describe the consequence of skin organ failure and give examples of the impact of this on the body and other organ systems.

**1. Introduction (Prof Tony Chu)**

Recognise the skin as a single complex organ

Recognise the diversity of skin conditions

Understand the role of the dermatologist

1. **Structure of the epidermis and adnexal structures (**Dr Fernanda Teixeira**)**

Understand the embryological development of the epidermis and adnexal structures

Understand the growth and differentiation of the keratinocyte

Recognise the immigrant cell populations in the epidermis

1. **Structure of the dermis and dermo-epidermal junction** **(Prof Tony Chu)**

Understand the embryological development of the dermis and its importance in the development of adnexal structures

Recognise the different collagens in the skin

Understand skin aging

Recognise the structure of the dermo-epidermal junction and its component parts

Understand the imp[ortance of the dermo-epiedrmal junction in the stability of the skin

1. **Blood vessels and nerves (**Dr Thiviyani Maruthappu**)**
* Understand the complex network of blood and lymphatic vessels in the skin and the redundancy inherent in the system.
* Recognise the different nerve endings in the skin
* Understand the role of the sympathetic nervous system in skin physiology
1. **Pigmentation of skin (**Dr Fernanda Teixeira**)**

Understand concept of the epidermal melanin unit

Recognised the different types of melanain and their impact on the skin phototype of the individual

Understand tanning and the damaging effects of UV exposure

**6 Hair & Nails (Dr Rakesh Patalay)**

Understand the growth cycle and anatomy of hair

Recognise the different types of hair

Understand the anatomy and growth of finger and toe nails

**7 Organisation of the skin immune system (Prof Tony Chu)**

Recognise the different components of the skin immune system

Understanding the interactions of the different elements

**8 Function of the skin (Prof Tony Chu)**

Understand the role of the skin in:

Social and sexual interaction

Barrier function

Percutaneous absorption

Protection against micro-organisms and destructive chemicals

**9 Thermoregulation (Dr Sangeeta Punjabi)**

Recognise the importance of the skin in establishing thermal homeostasis

Understand the importance of the dermal capillary network

Recognise the importance of sweating in thermal regulation

**10 Wound healing (**Dr Fernanda Teixeira**)**

Understand the mechanism by which the skin heals after trauma

Recognise the cellular elements that are important in wound healing

Regognised the humoral elements that are important in wound healing

**11 Skin in innate and acquired immune response (Prof Tony Chu)**

Understand the mechanism by which the skin heals after trauma

Recognise the cellular elements that are important in wound healing

Regognised the humoral elements that are important in wound healing

**12 Skin Organ Failure (**Dr Fernanda Teixeira**)**

Understand the concept of the skin as a single complex organ

Recognize the importance of the functions of the skin

Recognize that skin organ failure is incompatible with life

### Pathology 1 - Immunology

**Module Leaders:** Dr Peter Kelleher & Prof Karim Meeran

#### Learning Outcomes

**Lecture 1 – Introduction to Immunology**

* Give a brief overview using the ‘Immunology Tree of Life’ cartoon as to why study of immunology is important for our understanding of human health and disease.
* Outline the anatomy of the immune system with emphasis on primary and secondary lymphoid tissue and the mucosal immune system.
* Briefly describe the phenotype and function of cellular components of the immune system.

**Lecture 2 -The innate immune system**

* Understand the basic principles of innate immune responses and the timescale in which they occur
* Describe the major recognition strategies used by the innate system to detect the presence of infection and tissue damage.
* Describe the role of mediators of innate immunity such as complement, inflammatory cytokines and chemokines in host defence against infection.
* Be able to give some examples in which disorders of affecting components of the innate immunity are associated with human disease.

**Lecture 3 – Adaptive immune responses: T cell mediated immunity**

* Understand the basic principles of adaptive immune responses and the timescale in which they occur
* Outline the molecular mechanisms underlying the formation of T and B cell receptors
* Describe the developmental and maturational pathways of T cells
* Understand how T cells can recognize and respond to antigens
* Be able to classify the development pathways and function of different T cell subsets
* **Lecture 4 – Adaptive immune response: B cells mediated immunity**
* Outline the developmental and maturational of B cells
* Understand how B cell recognize and respond to antigen
* List the immunoglobulin classes. Describe their functions and relate these to their individual structure.
* Compare and contrast immune responses to T cell dependent and T cell independent immune responses

**Lecture 5 – Immune response to infection**

* Describe the initial immune response to infection
* Discuss immune responses to extracellular bacteria, intracellular bacteria, viruses, parasites and helminths
* Compare and contrast systemic and mucosal immune responses
* Outline clinical features which should prompt consideration of an underlying immune deficiency give some examples of a primary and secondary immune deficiencies

**Lecture 6 – Tolerance and Autoimmunity**

* Understand the concept and mechanisms of immunological tolerance.
* Discuss how defects in tolerance lead to autoimmune disease
* Describe mechanisms of tissue damage in autoimmune diseases
* List some examples of systemic and organ specific autoimmune diseases

**Lecture 7 - Allergy and Transplantation**

* Explain the immunological processes underlying the development of allergic diseases
* Describe the clinical features of IgE mediated immune responses
* Discuss how the immune system responds to alloantigens
* Outline the clinical features of transplant rejection

### Pathology 2 – General pathology, microbiology and infectious disease

**Module Leader:** Professor Karim Meeran

#### Learning Outcomes

**1. Acute Inflammation (Dr Justin Weir)**

* To understand the purpose, the causes and mechanisms of acute inflammation
* To understand the clinical manifestations of acute inflammation

**2 Chronic Inflammation (Dr Hazem Ibrahim)**

1. To understand the term “chronic inflammation”.
2. To know the causes of chronic inflammation.
3. To recognise the histological features of chronic inflammation.
4. To understand what is meant by the term “granuloma.”
5. To know some of the causes of granulomatous inflammation.

**3 Healing & Regeneration (Dr Gemma Petts, Dr Abigail Speller and Dr Ruchi Tandon)**

* tissue repair: 2 processes 🡪*regeneration* and *healing*
* the difference between healing and regeneration
* the essential components of regeneration
* the potential use of the science behind regeneration for future medical use**.**.

**4 Dysplasia & Carcinogenesis (Dr Jason Wang)**

* To learn the medical and scientific terminology for different growth disorders.
* To appreciate that cancer is a genetic disorder, resulting from an accumulation of non-lethal mutations to growth regulatory genes.
* To understand that origin and development of such mutations.
* To apply the dysplasia-carcinoma model of progression to different cancers.

**5 Malignancy in Clinical Practice (Dr Mihir Gudi)**

* To understand the difference between in in-situ and invasive cancer
* To recognize macroscopy and microscopy of common visceral malignancies.
* To understand the mechanisms of metastases.
* To understand the role of pathology within the MDT.
* To understand the importance of screening in prevention of cancer.

**6 Diagnostics -1 Chemical Pathology (Prof Karim Meeran)**

* List five common diagnostic tests carried out by the department of chemical pathology
* Know how to collect specimens for common tests including electrolytes, urea, glucose and glycosylated haemoglobin
* Describe a typical chemical pathology request form

**7 Diagnostics -2 Cellular Pathology (Prof. Rob Goldin)**

* List diagnostic tests carried out by the department of ceullar pathology
* Summarise the main steps involved in processing a specimen for routine histopathology diagnosis and indicate the likely time needed to carry out these steps.

### Microbiology

**At the end** of this part of the course, students should be able to

* Demonstrate an understanding of the burden of infectious diseases
* Demonstrate an understanding of the pathogenesis of infection.
* Know the common pathogens infectious to man and major virulence attributes thereof, be able to illustrate this with examples
* Understand how the laboratory is used to detect and diagnose infection.
* Explain how bacteria, viruses and other pathogens stimulate the immune system
* Understand the links between immune responses to pathogens and effects on vascular endothelium, and other organ systems
* Explain the pathophysiology of sepsis.
* Demonstrate an understanding of how infection is spread and the principles of infection prevention and control

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| **Microbes and Society: The Burden of Infectious Disease*** Describe the history of infectious diseases and microbiology and how it led us to the current situation
* Explain the concept of R0, the basic reproduction number and how this number affects infection rates
* Name the major infectious diseases in the world today
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| **Differentiating between Microbes 1: Bacteria*** Explain the basis of classification of bacteria and purposes beyond this
* Describe the components of bacteria and their functions in pathogenesis
* Describe, with examples, how these affect identification and management
 |
| **Differentiating between Microbes 2: Viruses, Fungi and Parasites*** Explain the basis of classification of micro-organisms and purposes beyond this
* Describe the components of viruses, fungi and parasites and their functions in pathogenesis
* Describe, with examples, how these affect identification and management
 |
| **Fever in the Returning Traveller*** Discuss the principles of diagnosis
* Name and describe common examples of causes of ‘fever in the returning traveller’
* Explain the use of prophylaxis
 |
| **Gram Negative Bacteria*** Describe features of gram negative bacteria
* Name the major clinically relevant pathogens and understand the range of disease caused
* Explain the targets for therapy in gram negative bacteria
 |
| **Diagnostic Tests in Microbiology*** Discuss the techniques available for the diagnosis of infection
* Discuss the relative merits and demerits of the techniques available
* Be aware of the quality assurance process that underlies all good laboratory practice
 |
| **Mechanisms of Action of Antibiotics** * Explain the basic principles of antibiotic actions
* Describe the major targets for antibiotics
* Describe the mechanisms of action of antibiotics
 |
| **Resistance to Antibiotics*** Understand the principles of antibiotic resistance
* Explain the key resistance mechanisms bacteria use
* Describe some of the common strategies in place to reduce antimicrobial resistance
 |
| **Principles of Good Antibiotic Prescribing*** Discuss the basics of good antibiotic prescribing, including:
	+ Dose
	+ Route of administration
	+ Timing
	+ Stop/Review
* Describe common strategies to influence antibiotic prescribing practice
 |
| **What are viruses and how do they replicate?*** Describe the structure and composition of viruses
* Describe the life-cycle of viruses and explain their replication
* Give examples of viruses
 |
| **How do viruses cause disease?*** Describe how viruses are transmitted
* Explain the outcomes caused by viral infection
* Give examples of clinically relevant viruses e.g. HIV and influenza
 |
| **How may virus diseases be prevented or treated?*** Describe, with examples, anti-viral drugs
* Describe, with examples, viral vaccination programmes
* Explain why the eradication of small pox was possible
 |
| **Malaria*** Discuss the life cycle of the malaria parasite
* Describe the clinical features and diagnostic workup
* Describe the management of a patient diagnosed with malaria
 |
| **Helminth Infections*** Describe the burden and life cycles of helminth parasites
* Explain the epidemiological approaches to effective international disease control
* Discuss the current state of control
 |
| **Fungi and Human Disease*** Describe ways in which fungus infects humans
* Name the major fungal infections that affect humans and understand the range of disease caused
* Describe anti-fungal treatment, with examples
 |
| **How Infection Spreads: How it is Interrupted*** Demonstrate an understanding of how infection is spread
* Describe the principles of infection prevention and control
 |
| **Physiological and Immunological Changes in Sepsis*** Understand how bacterial virulence leads to disease
* Describe the physiological and immunological changes that occur during sepsis
 |
| **HIV*** Describe the current world and UK epidemiology of HIV
* Describe the major clinical features of HIV infection
* Discuss the risk factors for HIV infection
* Describe the treatment of HIV
* Discuss, with examples, opportunistic infections

 |
| **TB*** Describe the current world and UK epidemiology of TB
* Describe the major clinical features of TB
* Discuss the risk factors for TB
* Describe the treatment of TB
* Discuss MDR-TB and XDR-TB, and the consequences of these for treatment and epidemiology of disease
 |
| **Gram Positive Bacteria*** Describe features of gram positive bacteria
* Name the major clinically relevant pathogens and understand the range of disease caused
* Explain the targets for therapy in gram positive bacteria
 |
| **Principles of Vaccination*** Describe the differences between active and passive immunity
* Discuss the reasons for immunization, including examples of the major clinically important vaccines and the diseases they work against
* Discuss the general considerations for a vaccination programme
* Give examples of vaccines from the current UK immunization schedule
 |
| **Case Studies*** Demonstrate an understanding of how infection is spread
* Describe the principles of infection prevention and control as applied to clinical cases
 |

###

### Renal

**Module Leader:** Dr Ruth Tarzi

#### Learning Outcomes

* Describe the structural organisation of the kidneys and urinary tract at the system and cellular levels.
* Explain the physiological mechanisms by which the various components of the kidney produce and regulate the composition of urine.
	+ Define Renal Clearance and Glomerular Filtration Rate and explain in principle how these may be measured in patients
* Understand the principal renal mechanisms responsible for homeostasis of water, electrolytes, pH, glucose and urea in the extracellular fluid.
	+ Appreciate the centrality of water in the control of cell volume, blood pressure and metabolism
	+ Understand the physiological implications of dehydration and how the body responds to it
	+ Understand the physiological implications of water loading states and how the body responds to them
	+ Understand the intracellular and extracellular balance of sodium and potassium ions including how and why the gradients are maintained.
	+ Understand why maintenance of appropriate pH is important physiologically
* Understand how renal mechanisms contribute to the control of blood pressure.
* Describe the sites and mechanism of action of the main classes of diuretics.
* Use the knowledge of kidney function and roles to:
	+ Understand how the body responds to overload and deficiencies of sodium and potassium, including the pathological features found in each situation.
	+ Determine the implications of sodium and potassium abnormalities in a number of different clinical scenarios.
	+ Identify several clinical scenarios in which acid-base balance is disrupted.
	+ Describe how the body deals with acid-base abnormalities in a number of different situations.
* Outline the principal causes of acute and chronic renal failure.
	+ Show awareness of the clinical features people may develop in acute and renal failure.
	+ Outline the possible ways of managing these patients.
	+ Show awareness of the different modalities of renal replacement therapy.

**LECTURES**

**Lecture 1: Sodium and potassium handling**

**Dr Elaine Clutterbuck** (Elaine.clutterbuck@imperial.nhs.uk)

* To understand the factors affecting sodium and potassium balance.
	1. the levels are regulated, and the role of the kidneys
	2. that there is a close relationship between - sodium and water homeostasis, and between potassium and hydrogen ion balance.
* To outline some of the clinical conditions associated with an imbalance of sodium / potassium
	1. their symptoms, signs and immediate management

**Lecture 2: Kidney Structure and Development**

**Dr Ruth Tarzi,** (r.tarzi@imperial.ac.uk)

* To understand the gross anatomy of the kidney
* To be aware of its principal relations to other structures
* To understand the basic structure of the glomerulus at a cellular level
* To appreciate how this structure controls its filtering function
* To know the component parts of the nephron and the basic function of each part
* To be able to outline the embryology of the kidney

**Lecture 3 : Illustration of renal anatomy and histology; renal biopsy: how to do and what to look for**

**Dr Candice Roufosse** (Candice.roufosse@imperial.nhs.uk)

* To understand the sampling and handling issues related to taking a medical renal biopsy
* To understand the purpose of the medical renal biopsy
* To be able to recognise in a renal biopsy some of the possible deviations from the norm

**Lecture 4: Renal blood flow and regulation**

**Dr Anisha Tanna,** (a.tanna@imperial.ac.uk)

* To learn about the anatomical and physiological concepts underlying the renal vasculature and perfusion,
* To provide insights into the intrinsing and extrinsic mechanisms involved in regulation of renal blood flow
* To gain understanding on pathophysiology of renal vascular impairmen

**Lecture 5: The lone Englishman lost in the Sahara Desert.**

**Dr Jeremy Levy (**j.levy@imperial.ac.uk)

To understand how the body handles water and what can go wrong. To understand how to interpret blood results in this context and how disorders of water balance might be managed.

**Lecture 6: Approaches to assessing renal function**

**Dr Peter Hill (**peter.hill4@nhs.net**)**

**NO LOS**

**Lecture 7: Discussion of clinical scenarios**

**Dr Damien Ashby** (d.ashby@imperial.ac.uk)

**NO LOS**

**Lecture 8: Renin-angiotensin system and conrol of blood pressure**

**Dr Nish Arulkumaran** (n.arulkumaran@imperial.ac.uk)

To learn about the blood pressure: what it does to/for the body, how do we measure it

RAS system - components and roles, therapeutic targets

Pathopysiology of hypertension and renal involvement

**Lecture 9: Drinking yourself to death: water loading states**

**Dr Ruth Tarzi** (r.tarzi@imperial.ac.uk)

* Understand the principle mechanisms responsible for the homeostasis of serum sodium, osmolality and total body water content.
* Understand the functions of antidiuretic hormone.
* Understand the physiological implications of water loading and how the body responds to it.
* Understand the causes and consequences of pathological water loading states eg syndrome of inappropriate ADH secretion, primary polydipsia, secondary hyperaldosteronism.

**Lecture 10: Acid-Base balance – physiology**

**Dr Doris Doberenz** (doris.doberenz@imperial.nhs.uk)

**NO LOS**

**Lecture 11: Acid Base Balance – illustrations from the critically ill patient’s physiology**

**Dr Doris Doberenz** (doris.doberenz@imperial.nhs.uk)

* To appreciate that Mendelian defects of salt handling can result in high or low blood pressure
* To understand some of the molecular pathophysiology involved and how this relates to commonly used drugs
* To appreciate that genetics is a dynamic area in which much is still to be learned

**Lecture 12: Renal causes of hypertension**

**Dr Peter Hill** (peter.hill4@nhs.net)

**NO LOS**

**Lecture 13: Erythropoeitin**

**Dr Peter Hill** (peter.hill4@nhs.net)

**NO LOS**

**Lecture 14: When the kidneys are lost**

**Dr Damien Ashby** (d.ashby@imperial.ac.uk)

**NO LOS**

**Lecture 15: Renal Physiology – clinical scenarios**

**Dr Jeremy Levy** (j.levy@imperial.ac.uk)

**NO LOS**

**Lecture 16: Lessons from nature: How genetic defects illustrate the physiology of salt and water balance**

**Dr Nish Arulkumaran** (n.arulkumaran@ucl.ac.uk)

* To understand the principles of the human genome project and how it relates to Mendelian genetic disorders
* To understand how Mendelian disorders can cause disease
* To appreciate how understanding Mendelian disorders can elucidate physiological processes on a molecular level

**Lecture 17: Clinical demonstration : video and meeting with renal patient**

**Dr Liz Lightstone** (l.lightstone@imperial.nhs.uk)

* Understand how kidney failure impacts on patients’ lives
* Understand the practicalities involved in dialysis and transplantation

**Lecture 18: Overview of kidney function and dysfunction with respect to learning objectives of the course**

**Dr Damien Ashby** (d.ashby@imperial.ac.uk)

**NO LOS**

**Lecture 19\*: Predict the consequences of loss of endocrine functions of the kidney Professor Karim Meeran** (k.meeran@imperial.ac.uk)

**NO LOS**

**Lecture 20\*: Control of calcium and phosphate: vitamin D, PTH and the kidney; Professor Karim Meeran** (k.meeran@imperial.ac.uk)

**NO LOS**

### Respiratory System

**Module Leader:** Dr Claire Shovlin

#### Learning Outcomes

#### At the end of the course, you will be able to

* Outline the basic anatomy and structure of the respiratory system.
* Describe the structure of the lung epithelium and the function of the cells contained within it.
* Explain how the lung develops in the foetus, and the changes that occur at birth.
* Describe the mechanics of breathing, including what is meant by ‘lung compliance and resistance.
* Describe the main muscles used in breathing and how these are utilised to generate different lung volumes. List the lung volumes that can be measured.
* Outline the principles of ventilation and explain the roles of PO2 and PCO2 in the pulmonary and alveolar ventilation
* Describe the delivery of oxygen to the body tissues and the removal of CO2 from the body.
* Describe the pulmonary circulation and the basis of pulmonary vascular disease.
* Explain the humeral and neural control of the airways
* Outline the control of breathing and how this changes during sleep
* Describe the sensory aspects of respiratory disease with reference to one example e.g. cough, dyspnoea, chest pain.
* Outline what is meant by the terms restrictive and obstructive lung disease and how they influence breathing.
* Outline the defence mechanism of the airway mucosa and how these are changed in airway hypersensitivity, specifically asthma.
* Distinguish between chronic and acute lung disease, explain the defence mechanisms and physiological consequences of infection in healthy lungs
* Describe the main causes of lung cancer and its basic presentation
* Describe the effects of extreme circumstances on ventilation and gas exchange in the normal lung.

**Lecture 1: Respiratory System I** (Dr Claire Shovlin, c.shovlin@imperial.ac.uk)

*This lecture should allow you .....*

* *To gain an overview of the respiratory system*
* *To list the main functions of the respiratory system*
* *To describe the respiratory pump*
* *To review the bones and muscles that enable expiration and inspiration*
* *To understand the passive properties of the respiratory system*
* *To explain what is meant by elastic recoil and compliance.*
* *To explain the factors that keep the non cartilagenous airways and alveoli open, utilising concepts of surface tension, the Law of Laplace, and pulmonary surfactant.*
* *To describe the relationship between airway resistance and airflow.*
* *To describe the factors that affect airway resistance centrally and peripherally.*
* *To understand the difference between obstructive and restrictive airways disease*

**Lecture 2: Respiratory System II** (Dr Claire Shovlin, c.shovlin@imperial.ac.uk)

*At the end of this lecture you should be able*

* *To understand the principles of gas exchange*
* *To provide three mechanisms that increase the rate of diffusion*
* *To understand Dalton’s Gas Law and apply at sea level and Everest*
* *To describe the volumes used in measuring alveolar and pulmonary ventilation*
* *To explain anatomic and physiological dead space*
* *To understand the concept of the Aa gradient and how this differs in disease and aging*
* *To understand the principle that PaCO2 is the primary driver of ventilation*
* *To understand the implication of Henry’s gas law for oxygen delivery*
* *To understand the principle of haemoglobin and oxygen carriage*
* *To appreciate the defences of the lung*

**Lecture 3: Lung Development** (Dr Matthew Hind, m.hind@imperial.ac.uk)

*At the end of this lecture you should be able to understand and describe.....*

* *The continuum of lung growth and development and factors that interfere with development*
* *How congenital defects arise*
* *Morphological and cellular events associated with phases of embryonic and postnatal lung development*
* *Early life origins of susceptibility to lung disease (Barker Hypothesis)*
* *Lung growth and evolution of lung function in the postnatal period*
* *Changes at birth, transition to air breathing*

**Lecture 4: Introduction to Lung Mechanics** (Dr Matthew Hind)

*At the end of this lecture you should be able*

* *To use practical examples to reinforce your understanding of the basic mechanics of the respiratory system*

*Note many of this is also covered in your practical sessions*

**Lecture5: Respiratory Muscles** (**Dr. Kevin Murphy** (kevin.murphy@imperial.ac.uk)

*At the end of this lecture you should be able to:*

* *Identify the principal muscles associated with inspiration and expiration.*
* *Understand the additional non-respiratory actions of these muscles.*
* *Understand how contraction of inspiratory muscles causes the chest wall to expand and the lungs to enlarge.*
* *Understand how contraction of expiratory muscles causes the chest wall to contract and the lungs to reduce in size.*
* *Recognise that these muscles will be differentially activated during different breathing states. Specifically: identify which will be active during quiet breathing, and which will be active when ventilatory demand is increased such as during exercise or during lung disease.*
* *In addition to their primary role in maintaining alveolar ventilation, know that respiratory muscles will control air movement during other behaviours including, speech, laughter, coughing, sneezing* *and vomiting*.

**Lecture 6: Pulmonary Circulation**. (Dr Claire Shovlin, c.shovlin@imperial.ac.uk)

At the end of this lecture you should be able to:

* *Compare the systemic and pulmonary circulations with respect to (i) the structure of the arteries and arterioles (ii) the mean arterial blood pressure and (iii) the overall resistance to blood flow.*
* *Explain how differences in the arterial blood pressures of the two circulations influence the structure of the two ventricles of the heart.*
* *Describe and explain the relative difference in blood flow to the bases and apices of the lungs in a standing human.*
* *Explain, with reference to the pulmonary circulation, the meaning of the terms vascular recruitment and hypoxic vasoconstriction.*
* *Explain the importance of hypoxic vasoconstriction in the foetus. Give one advantage and one disadvantage of this response in an adult suffering from chronic lung disease*
* *Explain what is meant by pulmonary oedema, and identify 3 pathophysiological mechanisms that may lead to this state.*
* *Explain the term “pulmonary embolism” and state the typical site of origin of such emboli.*
* *Describe the consequences of a large embolus with respect to*
	+ *the right side of the heart and the pulmonary circulation,*
	+ *the viability of the lung tissue and*
	+ *the implications for gas exchange.*
* *Give two reasons why lung disease may lead to pulmonary hypertension.*
* *Explain what is meant by “cor pulmonale”.*
* *Appreciate ventilation and perfusion matching in disease states*
* *Use ventilation and perfusion matching to illustrate the differences between normal, shunting, and dead space. Give one example of each.*
* *Predict what will happen to gas exchange if a shunt and dead space coexist*

*The last three concepts will be emphasized in the following quiz.*

**Lecture 7:** **Quiz:** (Dr Claire Shovlin c.shovlin@imperial.ac.uk)

*The purpose of this session is to test your knowledge in an informal setting, based on real results from real patients, and use of mock exam questions*

**Lecture 8: Sensory Aspects of Respiratory Disease** (Professor Fan Chung, f.chung@imperial.ac.uk)

*At the end of this lecture, in the indicated settings, you should be able to*

***General***

* *Understand how respiratory symptoms are generated and perceived*
* *Discuss the importance of measuring respiratory symptoms in clinical medicine and clinical research*
* *Outline the clinical causes and pathophysiological basis of the respiratory symptoms cough, chest pain (and dyspnoea, covered elsewhere):*

***Cough***

* *Describe the mechanics of a cough with reference to inspiration, expiration and closure of the glottis. Briefly explain how this manouevre serves to i) protect the lungs from inhaled noxious materials and ii) clear excessive secretions from the lower respiratory tract*
* *Identify the type and location of sensory receptor within the airways indicating how these are stimulated to give rise to cough. Identify the neural pathways which transmit this* ***afferent*** *(sensory) information to the brain*
* *Describe which regions of the brain are involving in generating the co-ordinated neural activity that results in a cough. Identify the* ***efferent*** *(motor) neural pathways and the main muscle groups which produce cough.*
* *Explain the concept of the sensitised cough reflex in disease as a basis for chronic cough.*
* *Discuss ways of controlling unnecessary cough*

***Chest pain***

* *Identify the type and location of sensory receptors within the thoracic cavity that when stimulated give rise to chest pain. Identify the neural pathways that transmit this afferent neural information to the brain.*
* *Describe in outline which regions of the brain are involved in the perception of pain*
* *Discuss the concept of referred pain in the chest*
* *Describe typical patterns of chest pain that can help in diagnosing the cause of pain*

***Dyspnoea***

* *Review the terms used by patients to describe the troublesome symptom of shortness of breath and its measurement*
* *Discuss the main important causes of shortness of breath and approach to management*

**Lecture 9: Regulation of Breathing** (Professor Mary Morrell, m.morrell@imperial.ac.uk)

* *Distinguish the primary purpose of the automatic reflex controller (regulate gas exchange for metabolic homeostasis) and the behavioural controller (other needs such as speech) .Give five examples of respiratory or non-respiratory functions achieved by control of respiratory muscle activity*
* *Identify neuronal groups in the brainstem that make up the automatic reflex controller for breathing, and structures in higher brain areas (suprapontine) that drive behavioural (non-automatic) control of breathing. Describe how they can act independently or interact for control of the respiratory pump.*
* *Locate sources of sensory input to the respiratory control system (central and peripheral chemoreceptors, lungs, airways and chest wall) and describe the common motor outputs.*
* *Describe the ventilatory response to increased arterial PCO2, decreased arterial PO2*
* *To define breathlessness (“dyspnoea”), consider its role in breathing control and its clinical impact (also considered in lecture 11).*
* *Distinguish the effects on respiratory control of the neurological conditions; ‘locked in’ syndrome and ‘congenital central hypoventilation syndrome’ (‘ondines curse’)*
* *Describe the effect sleep on the pattern of breathing and blood gases in healthy people*
* *Describe the changes in chemosensitvity (the ventilatory responses) that occur during sleep*
* *Understand the apnoeic threshold*
* *Explain how the changes in chemosensitivity and the apnoeic threshold led to central sleep apnoea.*
* *Describe the influences of sleep on the upper airway which, in some people leads to obstructive sleep apnoea.*
* *Know one major cardiac, one major respiratory disease that is exacerbated by the sleep-related changes in the control of breathing; briefly explain why sleep is detrimental to these patients*

**Lecture 10: More on blood gases and gas exchange.** (Professor Steve Semple) – see HANDOUTS

*At the end of this lecture you should be able to…..*

*1 Describe the qualitative changes in arterial blood pH. PCO2 and Base Excess in the following acid-base disturbances:*

*(i) Acute respiratory acidosis*

*(ii) Acute respiratory alkalosis*

*2 For (i) and (ii) above, describe the qualitative changes in arterial blood pH, PCO2 and Base Excess following renal compensation.*

*3. Describe the qualitative changes in arterial blood pH. PCO2 and Base Excess in the following acid-base disturbances:*

*(i) Metabolic acidosis with respiratory compensation*

*(ii) Metabolic alkalosis with respiratory compensation*

*Comment on the mechanism whereby metabolic changes in acid-base status lead to alteration in ventilation and hence respiratory compensation.*

*4. Describe the qualitative changes in arterial blood pH. PCO2, Base Excess and PO2 in a patient with (i) Type I respiratory failure (ii) Type II respiratory failure, in each case after full renal compensation.*

**Lecture 11: Gas exchange/Oxygen transport**

*(Unattended computer aided learning and run through with Dr Claire SHovlin*

* *Understand the factors that determine alveolar PO2 and PCO2*
* *Define hypoventilation and hyperventilation. Distinguish hyperventilation from the ‘hyperpnoea’ of exercise.*
* *Understand the relationship between alveolar PO2 and PCO2 and end-pulmonary capillary PO2 and PCO2. Explain the consequences of this for systemic arterial PO2 and PCO2.*
* *Know how (if at all) a reduction in Hb concentration in the blood (anaemia) affects PaO2, PaCO2 and oxygen content. Explain the effectiveness (or lack of it) of breathing an oxygen-enriched gas mixture in correcting any abnormalities associated with anaemia.*
* *Know how hypoventilation affects PaO2, PaCO2 and oxygen content. Explain the effectiveness (or lack of it) of breathing an oxygen-enriched gas mixture in correcting any abnormalities associated with hypoventilation.*

**Lecture 12: Lung function testing (Helium dilution and transfer factor)**

**H Tighe (h.tighe@imperial.nhs.uk)**

*At the end of this lecture you should be able to*

* *Identify lung volumes/capacities that CANNOT be measured by simple spirometry*
* *Describe the principle of measurement for lung volumes/capacities that can’t be measure by simple spirometry*
* *Explain how these volumes/capacities are affected by lung disease (e.g. hyperinflation, gas trapping in COPD)*
* *Describe the principle of the transfer factor test of gas diffusion across the alveolar membrane*
* *Be aware of the clinical conditions that can affect diffusion across the alveolar membrane*

**Lecture 13: Altitude and Air Travel.** (Dr Robina Coker Robina.Coker@imperial.nhs.uk)

*This lecture will be delivered on line. At the end, you should be able to understand and describe....*

* *How the different barometric pressures at altitude influences lung volumes and oxygenation*
* *Preflight assessment of cardiorespiratory status*
* *Hypoxic challenge tests*

**Lectures 14 and 17: Airways Disease.** (Dr Philip Ind p.ind@imperial.ac.uk)

*At the end of this lecture you should be able to understand and describe.....*

* *Practical management of airflow obstruction –distinction from restriction*
* *Spirometry, peak flow, other measurements*
* *Asthma vs COPD, clinical importance and diagnosis*
* *Asthma ‘triggers’*
* *Bronchodilator response*
* *Airway hyper-responsivenesss*
* *Sputum eosinophilia and neutrophilia*
* *Asthma-COPD overlap*
* *Practical management and introduction to Guidelines for asthma and COPD*

**Lecture 15: Diving (**Dr Peter Wilmshurst)
*At the end of this lecture you should be able to*

* *To understand how cardio-respiratory physiological principles are reinforced and modified by hyperbaric conditions*

**Lecture 16: Lung** **Cancer**. (Dr Claire Shovlin c.shovlin@imperial.ac.uk)

*At the end of this lecture you should be able .....*

* *To summarise the different cell types and function within the lung*
* *To summarise the pathophysiological steps leading to lung cancer*
* *To review the susceptibility of the lung to particular carcinogens*
* *To understand the different carcinogenic effects of smoking in different individuals*

**Lecture 18: Blood Gas Quiz**  (Professor Steve Semple)

*This will reinforce your earlier sessions.*

**Lecture 19: Exercise Physiology. (**Dr Luke Howard l.howard@imperial.ac.uk)

At the end of this lecture you will appreciate and understand

* physiological changes during exercise
* cardiopulmonary interaction
* reasons for exercise limitation
* strengths and limitations of exercise testing
* patterns of physiological changes during different disease states.

**Lectures 20 and 21: Respiratory Failure I and II.**

Dr Umeer Waheed**,** Umeer.Waheed@imperial.nhs.uk, Dr Richard Stumpfl,Richard.Stumpfle@imperial.nhs.uk

At the end of these lectures you should be able to

* Differentiate between Type 1 and 2 Respiratory Failure
* Outline the management of Type 1 and 2 Respiratory Failure
* Describe the importance of A-a gradient in Type 1 and 2 Respiratory Failure
* Describe the pathophysiology of Acute Respiratory Distress syndrome
* Outline the treatment modalities for Acute Respiratory Distress syndrome

**PRACTICAL SESSION OBJECTIVES**

**Practical 1: Lung volumes and spirometry**

**Hannah Tighe (****h.tighe@imperial.nhs.uk****)**

* *Describe spirometry procedures to measure lung volumes and capacities.*
* *State approximate values for lung volumes in a young healthy adult.*
* *Appreciate how body height, weight, age and gender influence lung volumes, and can be used to predict these values.*
* *List lung volumes/capacities that can be measured by simple spirometry.*
* *Be aware of how these volumes may change during exercise.*
* *Identify lung volumes/capacities (including: RV, FRC, VC, TLC) that are affected by: (1) severe chronic restrictive lung disorder (2) severe chronic obstructive pulmonary disorder, and be able to give reasons for these changes.*

**Practical 2: Airways resistance**

**Hannah Tighe (****h.tighe@imperial.nhs.uk****)**

* *Briefly describe two indirect methods to evaluate airways resistance.*
* *Define FVC, FEV1, and PEFR*
* *Explain why FEV1 is reduced in obstructive and in restrictive lung disease.*
* *Explain the significance of the ratio FEV1/FVC and state its normal value.*
* *Explain why the Wright Peak Flow meter is particularly useful for patients with asthma or COPD.*
* *State that values for FVC, FEV1, and PEFR are generally lower in females, increase with subject’s height* and decrease with age peaking at 20 years.

**Practical 3: Integrated exercise practical**

Dr. Luke Howard ( l.howard@imperial.ac.uk)

Dr. Kevin Murphy (Kevin.murphy@imperial.ac.uk);

* *Provide a basic explanation of the techniques used to obtain the following cardio-pulmonary measurements taken during exercise : Ventilation, Heart rate, Blood Pressure, O2 consumption and CO2 production. SpO2.*
* *Describe the normal cardio-respiratory response to an incremental work rate exercise test to exhaustion.*
* *Describe how the normal response is altered,(i) by the loss of one leg , (ii) heart disease, (iii), lung disease , (iv) training.*
* *Appreciate that some types of exercise may be limited by perceived exertion, while other forms (eg field exercise) may be limited by breathlessness.*
* *Realise that activities of daily life can elicit high levels of work eg climbing stairs.*

### THEME - Foundations of Clinical Practice

### Clinical Communication

**Module Leaders:** Dr Ged Murtagh & Dr Athina Belsi

##### Learning objectives – Graduate entry year 1 Autumn and Spring

These session objectives may include tasks you should be able to carry out after you have completed the relevant activity. They provide you with a way to assess how well you are keeping up with the material. Note that they are also provided to the external examiners as a guide to what you should know at the end of the course.

Based on the Background Information

* Define a patient-centred interview
* List reasons for adopting the patient-centred approach to interviewing
* Describe at least two different models of patient-centred consultations
* Identify skills used in patient-centred consultations

Session 1: Consultation skills – the initial approach

* Describe the General Medical Council competencies expected of new graduates in relation to communication
* Outline the content of the first year of “Clinical Communication”
* Describe and understand patient centred communication
* Identify key skills that can be used when meeting patients for the first time
* Understand the relation between content and process

Session 2: Patient centred communication

* Further exploration of patient-centred communication
* Describe the sources of non-verbal communication
* Describe the role of non-verbal communication in conveying emotion
* Describe the importance of non-verbal communication in consultations

Session 3: Interviewing volunteer patients

* Outline the skills necessary for approaching patients in a manner that enables you to communicate effectively and sensitively
* Identify communication and other professional skills that you used effectively
* Provide a rationale for using these skills
* Identify patient centred interviewing skills that you need to develop
* Make use of the feedback from the simulated patients to identify
	+ ways in which you will maintain your strengths in communicating
	+ ways in which you will improve on your communication weaknesses

Session 4: Interviewing a simulated patient

* Identify skills used effectively in simulated patient-centred interviews
* Receive feedback on communication skills from a simulated patient
* Receive feedback on communication skills from a tutor
* Develop awareness of personal strengths in communicating
* Develop awareness of personal weaknesses in communicating
* Identify ways in which communication strengths will be maintained
* Identify ways in which communication weaknesses will be improved

Session 5: History Taking (i): Content and Process

* Identify the key content features of a medical history
* Identify the skills necessary to establish the patient’s presenting complaint, the history of the presenting complaint and past medical history
* Interview and receive feedback from a simulated patient
* Practise using and integrating the skills associated with patient-centred interviewing while taking a medical history

Session 6: History taking with a simulated patient

* Receive feedback on your communication skills from a simulated patient
* Receive feedback on communication integrated with history-taking skills from a tutor and from peers
* Identify those history-taking skills that you used effectively in the simulated interviews
* Identify those skills that require further development
* Identify ways in which your communication and history-taking strengths will be maintained
* Identify ways in which your communication and history-taking weaknesses will be improved

Session 7: History Taking (ii): Social History

* Give examples of the range of problems to which diet contributes
* Discuss some of the problems in establishing a patient’s dietary habits
* Give examples of the key screening questions to ask every patient when taking a nutrition history
* Identify the skills necessary for an effective assessment of drug, alcohol and tobacco use
* Use a range of other questions to explore each area more deeply

Session 8: Revision Workshop

* Key learning points from the course will be covered
* There will be opportunities to observe and practice communication skills
* The exam format will be explained and there will be opportunities to ask questions

### Epidemiology and Public Health

**Module Leaders:** Dr Alex Bottle

**General course learning outcomes**

1. To describe global patterns of infectious and non-infectious disease, appreciate the disparities worldwide, and identify broad underlying causes for these patterns.
2. To appreciate the hierarchy of evidence in study design through knowledge of the strengths and weaknesses of various study designs, and to understand the importance of applying evidence to clinical decision making
3. To be able to understand and interpret the statistical findings commonly reported in scientific papers
4. To describe, and give examples, of the main methods of intervention to improve health, on a national and international scale, including education, protection and prevention.

**Session-specific learning outcomes**

Public and Global Health

* Understand the main causes of global mortality
* Appreciate how the main causes of mortality vary by region, and by age
* Understand the temporal patterns and their determinants
* Appreciate the distinction between morbidity and mortality
* Understand the major underlying risk factors for global ill-health

Routine data and observational studies

* To understand the major sources of routine data on health and illness in the UK
* To be able to describe the strengths and weaknesses of routine health data
* To understand standardised mortality ratios and provide examples of their use in comparing health in populations

Case control and cohort studies

* Know the different study designs used in epidemiological and clinical studies
* Be able to distinguish each type of study design by its core defining features
* To be able to describe the strengths and weaknesses of each type of study

Clinical Trials and Meta-analysis

Clinical trial LOs are not known (session is being revised)

* Understand the need for conducting systematic reviews and meta-analyses.
* Appreciate the potential biases and limitations of systematic reviews and meta-analyses
* Able to interpret the findings presented in published systematic reviews and meta-analyses
* Able to critically appraise published systematic reviews and meta-analysis

Tools of the Trade tutorial

* Be able to understand the concept of sampling (variation) in the context of whole population distributions
* Be able to understand that from a sample, estimates of the true underlying risk in a population can be calculated
* Be able to interpret a p-value and a confidence interval
* Be able to explain the role of statistical hypothesis testing and confidence intervals when dealing with chance
* Be able to interpret measures of association (relative risk, attributable risk, odds ratio) from simple examples
* Define confounding and understand the problems associated with it.
* Be able to describe methods for dealing with confounding (including stratification, standardization and regression)

Evidence-based medicine

* Recognise the role of evidence-based practice in clinical medicine
* List and define possible explanations for observed associations (chance, bias, confounding, causation), and cite examples of each
* Be able to describe the hierarchy of evidence in study design
* List the Bradford-Hill criteria for establishing causation and apply these to specific examples
* Be able to apply epidemiological skills to clinical decision making

The Epidemiology of Harm

* To recognize the scale of the problem of iatrogenic disease
* To describe the main data sources and ways of estimating the burden and severity of harm
* To list some principal ways of investigating the causes of harm

Preventative Medicine and Screening

* To describe and give examples of the main methods of intervention to improve health (e.g. health education, health protection, and prevention)
	+ To describe and give examples of the different levels of disease prevention
	+ To understand the principles and practice of screening
* To be able to define validity for screening tests and calculate specificity, sensitivity and predictive value
* To understand the criteria for screening programmes

Statistics for Medical Students

* Appreciate data types, distributions, and descriptors
* Know the primary statistical tests for common scenarios
* Appreciate the meaning of incidence and prevalence
* Distinguish odds ratios and relative risks
* Understand how to assess performance of a diagnostic test
* Understand metrics for risk reduction and their calculation

### Personal and Professional Development

**Module Leader:** Dr Elizabeth Muir

#### Learning Outcomes

*Session 1. Duties of a medical student*

* Understand the relevance of the Personal and Professional Development Course and be aware of the recommended format of the Portfolio of learning.
* Be able to identify the characteristics of a professional and describe the differences in the duties of a medical student and qualified doctor.
* Judge how to behave appropriately as a medical student and know what to do when medical professional values are put ‘at risk’
* compare and contrast differences in the duties of a medical student and qualified doctor based on guidance from the Faculty and the GMC’s professional behavior and fitness to practise document
* Apply Belbin descriptors to aspects of team/ group work e.g. in other tutorial groups such as PBL and First Clinical Attachment.

*Session 2. "The multi-professional health care team - and me"*

* Describe how you identify and seek help for your own health (physical, psychological and spiritual) needs
* Describe how you identify stress in yourself and others
* Explore the boundaries of responsibility towards yourself and other colleagues and be able to apply this knowledge to academic and clinical settings
* Define ‘whistle blowing’ and analyse its consequences
* Develop awareness of and begin to develop skills and strategies to manage and cope with stress and potential professional conflicts
* Give examples of the statements pertinent to health related issues in the Guidance for Medical students:*professional behaviour and fitness to practice.*

*Session 3. "But I just don't understand, doctor"- issues around the doctor-patient relationship” Los not included at present, but sessions are taught.Currently Sessions 2*

*Session 4. Patient Safety Los not included at present, but sessions are taught.Currently Sessions 4 & 5* (to be delivered at the beginning of year 2 of the GE MB BS Course)

### Problem Based Learning (PBL)

**Module Leader:** Dr Elizabeth Muir

#### Learning Outcomes

**1 Accessing information**

 Students will be able to access information in a variety of ways using libraries and other sources (e.g. texts, journals, people, on-line databases)

**2 Evidence based medicine and critical appraisal skills**

1. Students will be able to describe and understand Evidence Based Medicine (EBM) and know its benefits for clinical practice
2. Students will be able to describe the impact of EBM on clinical practice, including treatment
3. Students will be aware of the limitations of EBM (Clinical trials, ethical issues)

**3 Teamworking and Teaching skills**

In this part of the course they will also acquire skills in teamworking, medical decision-making and evaluating the use of data in evidence based practice. With respect to teamworking skills, each student will be able –

* to work effectively within a small group to process the PBL cases
* to perform as a leader and scribe
* to present his/her self-directed work to colleagues and to be skilled at feedback.

CASES VARY YEAR TO YEAR. CURRENTLY 6 CASES INSTEAD OF 7

### First Clinical Attachment

**Module leaders:** Dr Ros Herbert

#### Learning Outcomes

*Module 1: Illness, Health And Disease*

*Objectives of Module 1*

Knowledge:

* Be able to explain what is meant by ‘health beliefs’
* Be able to define ‘illness behaviour’ and give examples from the literature and your own patient.
* Debated at least two different models of health, and understand the implications of different definitions.

Skills, you will:

* Have begun to develop a facility for talking to patients about disease.
* Practised talking to patients about their beliefs and expectations.
* Have started your reflective portfolio
* Practiced your presentation skills

Attitudes:

* You will have been encouraged to demonstrate attitudes and behaviour towards patients, peers, teachers and health workers that are appropriate for a professional and to address and develop a holistic approach to the practice and application of medicine.

## Patient/Family Visit One: Introductory visit

**Learning Objectives**

**By the end of this visit you will have**

1. Gained experience in interviewing patients and their family members
2. Learned about the structure of the patient’s family
3. Practised obtaining information about a patient’s medical condition in the patient’s own words
4. Considered the sources of social, psychological, medical, family and other practical support available to an individual or family with medical needs
5. Practised using observational skills in order to build up a picture of the social circumstances and family relationships/ dynamics

## Patient/Family Visit Two: Symptoms, disease and illness

This visit ties in with the themes of module 1 of the course and deals with the patient’s own perspectives on health and illness (not necessarily related directly to the current condition).

**Learning Objectives**

**By the end of the visit you will have**

1. Considered the types of responses that individuals demonstrate when faced with symptoms of ill health
2. Examined the types of health beliefs that individuals or families may hold
3. Considered the triggers to and factors that may inhibit seeking medical help or advice
4. Gained an understanding of the range of conventional, complementary and lay sources of medical advice and treatment

***Module 2: The experience of health care***

*Objectives of Module 2*

Knowledge

* Understand the importance of communication on the patients’ experience of health care.
* Understand what is meant by patients’ ideas, concerns and expectations, in relation to the doctor patient consultation
* Understood the roles of other members of multidisciplinary teams
* Looked at the key elements contributing to patient satisfaction.

Skills

By the end of the module you will have:

* Conducted a patient satisfaction survey.
* Practised asking patients about their ideas, concerns and expectations.
* Observed doctor/nurse-patient consultations.
* Noted how professionals communicate with patients during history-gathering and examination.
* Completed a piece of written reflection.
* Continued your reflective portfolio

Attitudes

* You will have been encouraged to demonstrate attitudes and behaviour towards patients, peers, teachers and health workers that are appropriate for a professional. You will have considered the issues related to patient satisfaction and how you, as a doctor, will cope with criticism.

## Patient/family visit three: Experiences of health and social care

**Learning Objectives**

**By the end of the visit you will have**

1. Understood the importance of communication on the patient’s experience of health care
2. Understood what is meant by the terms ideas, concerns and expectations, in relation to the doctor patient consultation
3. Described a positive and less satisfactory experience of health care from the patient’s point of view
4. Outlined the journey of a patient during an episode of medical care

***Module 3: Living with a long term condition***

*Objectives of Module 3*

Knowledge

* The effect on patients and carers of the way in which a medical diagnosis /test results are shared.
* The effect of medical conditions on a person’s activities and quality of life
* How people cope with illness; the variety of attitudes and feelings experienced by people with ongoing illness or disability
* A comparison of the care needed with that available for the individual
* A comparison of the care needed with that available for the individual
* Three different models of disability

Skills

* Communication with people and their carers about long term medical problems
* Prepared and presented a poster to the group
* Used a portfolio to log your experiences and progress and received feedback on this
* Practiced the communication around ‘sharing difficult news’.

Attitudes

* Your attitudes to normality, chronic disease and disability
* How these attitudes may affect your behaviour towards people with long term problems

## Patient/Family Visit Four: Living with a long term condition

**Learning Objectives**

**By the end of the visit you will have**

1. Re-established the relationship and obtain an update regarding the current circumstances
2. Considered the adaptations that are made by the individual and his or her family, to a long term illness
3. Considered the effect on patients and carers of the way in which a medical diagnosis/ test results are shared
4. Deepened an awareness of the different ways in which individuals may respond or cope with long term illness or a life event

### Society & Health

**Module Leader:** Dr Mariam Sbaiti

#### Learning outcomes

#### To be able to explain the difference between negative, positive and functional definitions of health and to recognise their use

1. To be able to explain the difference between biological, psychological and social perspectives on ill health
2. To understand the impact of these distinct perspectives on healthcare and the doctor-patient relationship and adherence to treatment
3. To describe preventive, illness and sick-role behaviours and provide examples of the proportion of these behaviours taken to doctors and other healthcare providers
4. To describe varied pathways and patterns of healthcare including lay referral and self management
5. Define stigma and deviance, and give examples of diseases which are stigmatised and understand responses including health activism
6. To recognise distinct and changing forms of social stratification including economic, geographic, cultural and by personal attribute such as gender, ethnicity or age
7. To describe the distribution of these social strata in a population and understand their relationship to health inequalities
8. To recognise the concept of professions as one form of social stratification, and understand the changing role of the medical profession
9. To assess the relative contribution of medicine to health
10. To understand that several forms of social differentiation will influence any one doctor-patient encounter and to be able to describe some common examples, e.g. housing, employment, status, disability.
11. To explain the different mechanisms through which social factors affect health with reference to specific examples
12. To describe the medicalisation of the life course and explain its relationship to the growth of the pharmaceutical industry and market-friendly policies at national and international level
13. To recognise different forms of knowledge and their changing contribution to evidence-based medicine, clinical skills, professional monopoly and asymmetries of power in healthcare
1. [↑](#footnote-ref-1)