UNSW AUSTRALIA | Medical Sciences Medicine

DEPARTMENT OF PHYSIOLOGY

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SECOND YEAR PHYSIOLOGY

SESSION 2, 2015

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Please read this manual/outline in conjunction with the following pages on the

School of Medical Sciences website:

- Advice for Students
- Learning Resources

(or see "STUDENTS" tab at medicalsciences.med.unsw.edu.au)

EXAMINER AND COURSE CO-ORDINATOR

Course Convenor:	**Dr. Lesley Ulman** **l.ulman@unsw.edu.au**	**Room 204 West Wing Wallace Wurth** **(ph: 9385 3601)**
Co-convenor:	**Dr. Nicole Marden** **n.marden@unsw.edu.au**	**Room 204 West Wing Wallace Wurth** **(ph: 9385 3601)**

If you need to consult with either, appointments can be set up through email.

LECTURERS IN THIS COURSE

Dr K.Gibson	**k.gibson@unsw.edu.au**
Prof G.Housley	**g.housley@unsw.edu.au**
Dr N.Marden	**n.marden@unsw.edu.au**
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Prof M.Morris	**m.morris@unsw.edu.au**

If you require a consultation with any of these staff, appointments can be made via email.

The Department of Physiology is part of the School of Medical Sciences and is within the Faculty of Medicine. The teaching staff involved in the running of this course are now located on the second and third floors of the west wing of the Wallace Wurth building. Students are not able to access these areas and if you wish to contact one of us you will need to do so by email and we can organize to meet with you if necessary.

General inquiries can be made to the school teaching administrator Carmen Robinson (9385 2464, carmen.robinson@unsw.edu.au) who is located on the Ground Floor of the Biological Sciences Building room G27.

Professor Gary Housley is Head of Department and appointments to see him may be made through email (g.housley@unsw.edu.au).

OBJECTIVES OF THE COURSE

This course is offered to second year students and follows on from the first session course. The major aims of this course are to provide students with a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body. It should be noted that, although introductory, this course in Human Physiology is comprehensive in scope. Areas treated in detail include Endocrine Physiology, Reproductive Physiology, Respiration, Kidney & Body Fluids and Gastrointestinal Physiology.

It should also be noted that, where appropriate, subject areas are treated quantitatively as well as qualitatively, an approach that requires students to have at least a basic knowledge of mathematics and chemistry.

TEXTBOOK

PRINCIPLES OF HUMAN PHYSIOLOGY by Cindy L. Stanfield, Benjamin Cummings, 5th edition, 2013 .Books are available from the UNSW bookshop.

This textbook comes with an Interactive Physiology CD. Several self-study sessions based on this Interactive Physiology CD have been designed to allow you to revise the lecture material in your own time. There is no set time allocated for these suggested self-study sessions – you are encouraged to work through these sessions in your own time as a supplement to lectures and tutorials. Please refer to the end of this practical manual for further details on the self study sessions.

COURSE STRUCTURE

This is a 6 unit of credit course. There are 2-3, one hour lectures per week (Tue 9-10, Wed 9-10 and Fri 3-4). Lectures will provide you with the concepts and theory essential for understanding the fundamental processes of body function. The Fri 3-4 slot on some occasions will be used for a tutorial which aids in better understanding of lecture material.

The practical classes are a major component of the course and comprise a fortnightly, supervised 3 hour laboratory session during which students typically work in small groups of about 5 and carry out the laboratory exercises outlined in this practical manual. These sessions will give an insight into how knowledge is obtained, and how the results of experiments depend not only on what we measure but how we measure it. Two additional sessions will be computer based, rather than of a practical nature. Although these will be unsupervised the material is still examinable.

APPROACH TO LEARNING AND TEACHING

Although the primary source of information for this course is the lecture material, effective learning can be enhanced through self-directed use of other resources such as textbooks and Moodle. Your practical classes will be directly related to the lectures and it is essential to prepare for practical classes before attendance. It is up to you to ensure you perform well in each part of the course; preparing for classes; studying for quizzes and exams and seeking assistance to clarify your understanding. Past exam questions are provided to assist you in preparing for examinations.

UNSW LEARNING OUTCOMES

UNSW aims to provide an environment that fosters students achieving the following generic graduate attributes:

1. the skills involved in scholarly enquiry
2. an in-depth engagement with the relevant disciplinary knowledge in its interdisciplinary context
3. the capacity for analytical and critical thinking and for creative problem-solving
4. the ability to engage in independent and reflective learning
5. information literacy - the skills to appropriately locate, evaluate and use relevant information
6. the capacity for enterprise, initiative and creativity
7. an appreciation of, and respect for, diversity
8. a capacity to contribute to, and work within, the international community
9. the skills required for collaborative and multidisciplinary work
10. an appreciation of, and a responsiveness to, change
11. a respect for ethical practice and social responsibility
12. the skills of effective communication.

Not every course addresses all these attributes evenly. In second year physiology, attributes 1-4 are most relevant. The following are more specific learning outcomes for this course designed to incorporate some of the generic graduate attributes listed above in a more context specific form.

SPECIFIC LEARNING OUTCOMES

By the end of this course students are expected to have gained a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body. More specifically students should have a basic knowledge of

Temperature Regulation
- normal body temperature and how it is regulated

Endocrine Physiology
- the mechanisms of hormone action
- simple feedback-loop endocrine systems
- hypothalamus and pituitary gland
- thyroid gland
- adrenal gland

Reproduction
- male reproductive system
- female reproductive system
- pregnancy

Respiratory System
- anatomical features and their physiological significance
- ventilation
- oxygen transport
- carbon dioxide transport and blood buffering
- respiratory mechanics
- control of respiration

Gastrointestinal System
- overview of the gastrointestinal tract
- gastric secretion, motility and emptying
- digestive processes of the small intestine
- liver and biliary system
- chemical digestion and absorption of nutrients
- appetite control
- digestive processes of the large intestine

Kidney and Body Fluids
- body fluids
- renal structure, renal blood flow and glomerular filtration
- reabsorption and secretion
- evaluation of renal function
- tubular structure and function along the nephron
- renal water homeostasis
- urinary concentrating mechanisms
- renal sodium and potassium balance
- renal acid-base balance

ASSESSMENT

	%Total Marks
Mid-session Theory Exam (50 minutes duration) The mid-session exam will be held on Wednesday 9th September 2015 and will consist of the following: • 15 multiple choice questions on material covered in all Temperature Regulation, Endocrine, Reproduction and Respiration lectures and tutorials. • Two short answer questions; one on Endocrine and one on Respiration.	**30%**
End of Session Exam (2 hours duration) The end of session exam will consist of the following: • 15 multiple choice questions on all Gastrointestinal Tract and Kidney and Body Fluids lectures and tutorials. • Three short answer questions; one on Reproduction, one on Gastrointestinal Tract and one on Kidney and Body Fluids. • 30 multiple choice questions on material pertaining to the practical classes in Session 2. You will **not** be able to take your prac books into the exam.	**50%**
Online Feedback Quizzes There will be a series of 5 online feedback quizzes throughout the session covering each topic. These quizzes will be made available online a few days after the conclusion of each lecture series. These quizzes are to be used as a study aid and you will receive immediate detailed feedback after submitting your answers. The quizzes are to be attempted in your own time and each quiz will be accessible for a period of one week. You may attempt these quizzes as many times as you wish within this period. You will receive 2% towards your overall grade for each quiz provided you achieve a minimum score of 90% for the quiz.	**10%**

ALL MULTIPLE CHOICE QUESTIONS EXAMINING LECTURE AND TUTORIAL MATERIAL IN THE MIDSESSION AND END OF SESSION EXAMS WILL BE DRAWN FROM THE BANK OF QUESTIONS USED IN THE ONLINE QUIZZES THROUGHOUT THE SESSION.

PLEASE NOTE THAT THIS DOES NOT APPLY TO MULTIPLE CHOICE QUESTIONS BASED ON PRACTICAL CLASS MATERIAL – THESE QUESTIONS WILL NOT HAVE BEEN SEEN BY YOU PRIOR TO THE END OF SESSION EXAM.

A timetable of online quiz dates and periods of accessibility will be posted up on Moodle early in the session.

Please note that online feedback assessments are intended to motivate your study, provide feedback on your progress and to stimulate your learning. There is published data which demonstrates that students who participate in online feedback assessments perform significantly better than their peers in end of course examinations.

When attempting each online feedback assessment, please complete it under exam conditions (by exam conditions, we mean you should do it by yourself, don't look up the answers as you do it, and commit yourself to an answer), at least the first time you attempt it. This will provide the most realistic appraisal of your performance.

Give yourself plenty of time, and attempt the feedback assessment in a place where you won't be interrupted. If you are attempting to simulate exam conditions, you should allow up to 2 minutes per question.

Write down items that you are not sure about as you go. Even if you get the question right you should still read further about anything that is unclear to you.

If you don't agree with, or can't understand the reason for an answer, ask the appropriate member of academic staff. If you are not sure who that is, ask your colleagues or the course convenor.

Technical problems regarding access to the assessment should be directed to Fiona Wilson (f.wilson@unsw.edu.au).

Practical Quizzes **10%**

You will be divided into small working teams of approximately 6 students within your practical group at the beginning of the session and will remain in these teams throughout the session. Random practical quizzes will be conducted immediately before some of the practical classes. These quizzes will contain a mixture of questions on that day's work and on the previous **supervised** practical class that you did.

Please note that the self-directed learning classes on GIT and Renal Endocrine are not supervised practicals and questions on these practicals **will not** be included in the practical quizzes but **will** be examined in the end of session exam. You will be required to do each quiz individually first and then after collection of the papers, you will be required to perform each quiz as a team. Marks will be awarded to both your individual scores and your team score. A minimum of three quizzes will be given throughout the session and your mark for this component will be an average of **all** the quizzes you are given.

GENERAL INFORMATION

***There is an honours program conducted by the School*.** The Honours program is co-ordinated by Dr Thomas Fath (t.fath@unsw.edu.au). Any students considering an Honours year should discuss the requirements with the co-ordinator. Outstanding students may be considered for scholarships offered by the University and School and these are offered annually.

Postgraduate research degrees

The Department of Physiology offers students the opportunity to undertake a Doctorate *(Ph.D)*. For further information contact the co-ordinator, Dr Pascal Carrive (P.Carrive@unsw.edu.au).

Departmental Vacation Scholarships: The Department of Physiology supports several summer vacation scholarships each year to enable good students to undertake short research projects within the department. For further details contact Vicky Sawatt, our "Honours and Postgraduate Research Administrator" on 9385 8195 or email her at v.sawatt@unsw.edu.au. You may also like to visit the relevant page on our website:
http://medicalsciences.med.unsw.edu.au/students/undergraduate/summer-research-awards

ATTENDANCE REQUIREMENTS

Attendance at ALL practical classes is compulsory FOR ALL STUDENTS, **and must be recorded in the class roll ON THE DAY OF THE CLASS. It is your responsibility to ensure that the demonstrator records your attendance and no discussions will be entered into after the completion of the class.**

Satisfactory completion of the work set for each class is essential and **IS A REQUIREMENT FOR PASSING PHYSIOLOGY**. Non-attendance for other than documented medical or other serious reasons may make you ineligible to successfully complete this course. At the very least you may be required to pass an additional oral examination on the practical classes, as well as undertaking the normal practical exam and quizzes.

Students who miss practical classes due to illness or for other reasons must submit a medical certificate to academic staff during lab time or leave it with a member of the technical staff located in room 118 East Wing Wallace Wurth Building **WITHIN 7 DAYS (practical classes only)** of missing a class. If received after this time, no consideration will be given and the student will be marked absent from that class. **The following details must be attached: Name, Student number, Course number, Group number, Date of the class, Name of class missed.**

The practical component of the final exam is compulsory FOR ALL STUDENTS.

PLEASE NOTE that missing any examination requires lodging a medical certificate via Online Services in myUNSW within **3 DAYS** (further details on how to do this are linked from the SoMS Student advice page: http://medicalsciences.med.unsw.edu.au/students/undergraduate/advice-students)

NOTICES

All current timetables, notices and information relevant to you will be available on Moodle. It is your responsibility to check Moodle regularly.

All lectures are taped by the Echo360 system and can be accessed via Moodle. Textbooks and some reference materials are available through Library open reserve.

HANDWRITING

Students whose writing is difficult to understand will disadvantage themselves in their written assessment. Make every effort to write clearly and legibly. Do not use your own abbreviations.

REPEATING STUDENTS

Practical class exemptions may be granted to repeat students but students **must** check with the course convenor whether they have exemption **prior** to their first practical class. All students must be familiar with the material covered in the practical classes. All students must do the practical component of the final exam.

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LECTURE AND TUTORIAL TIMETABLE

Week No. Commencing	LECTURE Tuesday 9am CLB 7	LECTURE Wed 9am CLB 7	LECTURE Friday 3pm Lecture-CLB 7 Tutorials-Mathews B & C, WW LG03, CLB 1, 2 & 5
1 27-Jul	**Introduction** ULMAN	**Temperature Regulation** GIBSON	**Endocrine 1** HOUSLEY
2 3-Aug	**Endocrine 2** HOUSLEY	**Endocrine 3** HOUSLEY	**Endocrine 4** HOUSLEY
3 10-Aug	**Endocrine 5** HOUSLEY	**Reproduction 1** MARDEN	*Tutorial – Endocrine*
4 17-Aug	**Reproduction 2** MARDEN	**Respiration 1** KLUGMANN	**Respiration 2** KLUGMANN
5 24-Aug	**Respiration 3** KLUGMANN	**Respiration 4** KLUGMANN	**Reproduction 3** MARDEN
6 31-Aug	**Respiration 5** KLUGMANN	**Respiration 6** KLUGMANN	*Tutorial – Respiration*
7 7-Sep	**Gastrointestinal Tract 1** BRITTON	**MID SESSION EXAM**	**Gastrointestinal Tract 2** BRITTON
8 14-Sep	**Gastrointestinal Tract 3** BRITTON	**Gastrointestinal Tract 4** **Appetite control** MORRIS	**Gastrointestinal Tract 5** GIBSON
9 21-Sep	**Gastrointestinal Tract 6** BRITTON	**Gastrointestinal Tract 7** BRITTON	*Tutorial – GIT*
MID-SEMESTER BREAK 26TH Sept – 5th Oct			
10 5-Oct	**Kidney & Body Fluids 1** GIBSON	**Kidney & Body Fluids 2** GIBSON	**Kidney & Body Fluids 3** GIBSON
11 12-Oct	**NO LECTURE**	**Kidney & Body Fluids 4** GIBSON	**Kidney & Body Fluids 5** GIBSON
12 19-Oct	**Kidney & Body Fluids 6** GIBSON	**Kidney & Body Fluids 7** GIBSON	*Tutorial –Kidney*
13 26-Oct	**NO LECTURE**	**NO LECTURE**	**NO LECTURE**

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PRACTICAL TIMETABLE

week	day & time	date	group	Supervised practical Wallace Wurth East Wing LAB 115	group	Self-directed computer class Wallace Wurth East Wing LAB 120
1	Tues 10-1 Tues 2-5 Wed 10-1	28/7 28/7 29/7	All groups	**NO PRACTICALS**		
2	Tues 10-1 Tues 2-5 Wed 10-1	4/8 4/8 5/8	1 & 2 3 & 4 5 & 6	**TEMPERATURE REGULATION**		
3	Tues 10-1 Tues 2-5 Wed 10-1	11/8 11/8 12/8	7 & 8 - 9 & 10	**TEMPERATURE REGULATION**		
4	Tues 10-1 Tues 2-5 Wed 10-1	18/8 18/8 19/8	1 & 2 3 & 4 5 & 6	**THYROID PHYSIOLOGY**		
5	Tues 10-1 Tues 2-5 Wed 10-1	25/8 25/8 26/8	7 & 8 - 9 & 10	**THYROID PHYSIOLOGY**		
6	Tues 10-1 Tues 2-5 Wed 10-1	1/9 1/9 2/9	1 & 2 3 & 4 5 & 6	**ENDO/REPRO PHYSIOLOGY**		
7	Tues 10-1 Tues 2-5 Wed 10-1	8/9 8/9 9/9	7 & 8 - 9 & 10	**ENDO/REPRO PHYSIOLOGY**		
8	Tues 10-1 Tues 2-5 Wed 10-1	15/9 15/9 16/9	1 & 2 3 & 4 5 & 6	**RESPIRATORY GAS EXCHANGE**		
9	Tues 10-1 Tues 2-5 Wed 10-1	22/9 22/9 23/9	7 & 8 - 9 & 10	**RESPIRATORY GAS EXCHANGE**	1 & 2 3 & 4 5 & 6	**SELF DIRECTED LEARNING - GIT**
MID-SEMESTER BREAK 26TH Sept – 5th Oct						
10	Tues 10-1 Tues 2-5 Wed 10-1	6/10 6/10 7/10	1 & 2 3 & 4 5 & 6	**CONTROL OF RESPIRATION**	7 & 8 - 9 & 10	**SELF DIRECTED LEARNING - GIT**
11	Tues 10-1 Tues 2-5 Wed 10-1	13/10 13/10 14/10	7 & 8 - 9 & 10	**CONTROL OF RESPIRATION**	1 & 2 3 & 4 5 & 6	**SELF DIRECTED LEARNING - RENAL ENDOCRINE**
12	Tues 10-1 Tues 2-5 Wed 10-1	20/10 20/10 21/10	1 & 2 3 & 4 5 & 6	**VOLUME & SOLUTE CONTROL**	7 & 8 - 9 & 10	**SELF DIRECTED LEARNING - RENAL ENDOCRINE**
13	Tues 10-1 Tues 2-5 Wed 10-1	27/10 27/10 28/10	7 & 8 - 9 & 10	**VOLUME & SOLUTE CONTROL**		

COMPULSORY LAB COATS REQUIRED FOR "SHADED" CLASSES

TEMPERATURE REGULATION

1 Normal body temperature. Core and shell. Heat transfer, heat production, heat loss by conduction, convection, radiation and evaporation. Temperature regulation – concept of set point; hypothalamic centres, afferent and efferent mechanisms. CVS homeostasis in heat. Heat acclimatization. Fever.

ENDOCRINOLOGY

1. **Mechanisms of hormone action**. Overview of the endocrine glands: common characteristics of endocrine glands. Hormones production and signaling. Endocrine, paracrine and autocrine action.

2. **Simple feedback-loop endocrine systems**. Pancreas - structure and function. Control of insulin and glucagon secretion: regulation of plasma glucose. Type I and type II diabetes. The heart and atrial natriuretic peptide: regulation of plasma volume. The kidneys: erythropoietin, calcitriol and the renin angiotensin system.

3. **The hypothalamus and pituitary gland**. Interactions between the hypothalamus and pituitary. Control of the hypothalamus from neural inputs. Hypothalamic releasing hormones. Anterior and posterior pituitary hormones. Control of synthesis, secretion and actions of pituitary hormones.

4. **The thyroid gland**. Thyroid gland structure and histology. Synthesis of thyroid hormones. Control of thyroid hormone secretion. Action of thyroid hormones on metabolism and development. Hyperthyroidism and hypothyroidism. Actions of parathyroid hormone and calcitonin in calcium homeostasis.

5. **Adrenal gland**. Adrenal gland structure and histology; adrenal cortex and medulla. Synthesis and secretion of adrenal steroid hormones from the cortex and catecholamines from the medulla. Interaction of aldosterone with the renin-angiotensin system of the kidneys. Metabolic actions of glucocorticoids and dysfunction. Actions of catecholamines.

REPRODUCTION

1. **Male reproductive system**. A description of the function of each component of the male reproductive tract. The hormonal control of testosterone production and spermatogenesis by the hypothalamic-pituitary axis. Composition of semen. Actions of testosterone.

2. **Female reproductive system**. A description of the function of each part of the female reproductive tract. Hormonal control of the menstrual cycle: the growth of a follicle in the ovary and the hypothalamic-pituitary axis. Actions of oestrogen and progesterone.

3. **Pregnancy**. The process of fertilization of an ovum by sperm and the implantation of the developed blastocyst in the uterine lining. The production of hormones by the placenta to maintain pregnancy. The interaction between the mother, the placenta and the fetus in steroid hormone synthesis.

RESPIRATORY SYSTEM

1 **Introduction and gases.** Basic lung-airway anatomy; relation to function. Airway and air flow properties in respiration. Pulmonary circulation. Particle removal mechanisms. Gas laws. Gas solubility. Gas tension in a solution. Composition of air.

2 **Ventilation.** Lung volumes and capacities. Spirometry. Residual volume. Ventilation. Dead space and alveolar ventilation. Oxygen uptake / carbon dioxide output / respiratory exchange ratio.

3 **Oxygen transport.** Composition of alveolar air at rest. Venous and arterial blood gas tensions. Blood oxygen transport - need for a carrier. The haemoglobin molecule. Oxygen capacity, saturation and content. Hb-O_2 equilibrium curve (OEC) and its features (shape, CO_2 and pH (Bohr), temperature effects, 2,3 DPG). Haemoglobin compared to myoglobin. Carbon monoxide poisoning.

4 **Carbon dioxide transport and blood buffering.** CO_2 transport in blood. Effect of oxygenation on CO_2 transport (Haldane effect). Blood CO_2 equilibrium curves. Acids and bases - fundamental concepts. Henderson Hasselbalch Equation. Blood buffering systems. Importance of haemoglobin. Simple acid-base disorders.

5 **Respiratory Mechanics.** Muscles of respiration. Elastic properties of the lung. Compliance. Surface tension. Surfactant. Elastic properties of the chest wall. Compliance of lungs and chest wall. Relaxation pressure-volume curves. Airway resistance. Intrapleural and intra-alveolar pressures and gas flow during the respiratory cycle.

6 **Control of Respiration.** 'Central controller' (pre-Botzinger complex - critical for rhythm generation in breathing) and role of the medulla and pons. Respiratory related neurones. Sensors: Chemical control of breathing via central chemoreceptors and peripheral chemoreceptors (carotid and aortic bodies). Other receptors in lungs, upper airways etc. Interaction of O_2 and CO_2 in control of respiration. Role of pH. Control of respiration in exercise.

GASTROINTESTINAL SYSTEM

1. **Overview of gastrointestinal tract (GIT) structure and function.** Neural and hormonal responses mediate GI responses. Patterns of motility in the GI tract. Physiological basis of GI tract motility. The enteric nervous system and digestive reflex processes. (FB)

2. **Digestive processes occurring in the mouth and stomach.** Composition and function of saliva. Control of saliva secretion. Swallowing. Stomach anatomy. Composition and function of gastric juice. Mechanism and regulation of gastric acid secretion. Gastric motility,filling and emptying. Vomiting. Gastric ulcers and reflux. (FB)

3. **Digestive processes occurring in the small intestine.** Structure of the small intestine and role in digestion and absorption. Composition and function of pancreatic juice. Regulation of pancreatic juice secretion. Pancreatic enzymes and brush border enzymes. Motility in the small intestine. Motility disorders. (FB)

4. **Appetite control:** Factors that control appetite in the short and long term. Role of the brain in appetite control - brain:gut communication and the importance of adipose tissue as an endocrine organ. What goes wrong in obesity? (MJM)

5. **Liver and biliary system.** Functional anatomy of the liver. Liver blood flow. Functions of the liver. Formation and secretion of bile. Bile salts. Bilirubin metabolism and secretion. The gall bladder. Factors causing gall bladder contraction. Gallstones. (KG)

6. **Digestion and absorption of nutrients**. Enzymatic hydrolysis of carbohydrate, protein and lipid. Transepithelial absorption and active transport of nutrients. Absorption of vitamins, electrolytes and water. Malabsorption of nutrients and food allergies. (FB)

7. **Digestive processes of the large intestine.** Anatomical features and functions of the large intestine. Role of bacterial flora in the colon. Fermentation. Motility of the large intestine. Defecation. (FB)

KIDNEY AND BODY FLUIDS

1. **Body fluids and introduction to the kidney.** Properties of solutions. Osmosis, osmolality, osmolarity, tonicity, osmotic pressure, colloid osmotic pressure. Volume and composition of the body fluid compartments. Functions of the kidneys. Basic anatomy of the urinary system.
2. **Renal structures, renal blood flow and glomerular filtration.** Structure of the nephron. Cortical and juxtamedullary nephrons. The juxtaglomerular apparatus. Basic steps in forming urine. Renal blood flow and pressure in the renal vessels. Autoregulation. The renin angiotensin system. Renal sympathetic nerves. Glomerular filtration and glomerular filtration rate (GFR). Equation for single nephron GFR. Filtration fraction. Effects of arteriolar tone on RBF and GFR.

3. **Reabsorption and secretion; Evaluating renal function.** Measurement of GFR. Measurement of renal plasma flow. Concept of effective renal plasma flow. Definition and calculation of clearance. Calculation of filtered load, excretion rate, net reabsorption or secretion. Comparison of filtrate and urine. Basic mechanisms of transepithelial transport. Transepithelial transport of sodium, water, glucose. Tm limited reabsorption.

4. **Tubular structure and function along the nephron; Renal water homeostasis.** Structure and function of the proximal tubule. Glomerulotubular balance. Transport properties of the loop of Henle, distal convoluted tubule and collecting duct. Water balance. Regulation of plasma osmolality. Thirst. Making a dilute or concentrated urine. Obligatory water loss.

5. **Urinary concentrating mechanisms; Renal sodium homeostasis.** The medullary osmotic gradient and its generation and maintenance: countercurrent multiplication, urea recycling and countercurrent exchange. Antidiuretic hormone. Aquaporins, Protecting renal medullary cells from hypertonicity. Sodium balance. Sodium and extracellular volume. Detecting changes in sodium intake. Efferent mechanisms to vary sodium output.

6. **Renal sodium and potassium balance.** Hormones involved in sodium balance. Angiotensin II. Aldosterone. Atrial natriuretic peptide. Potassium balance. Exchange of potassium between extracellular and intracellular fluid. Renal handling of potassium. Mechanism of potassium secretion by principal cells. Factors affecting potassium secretion.

7. **Renal acid-base balance.** Brief revision of fundamental concepts and body acid base balance. Role of the kidneys in acid-base balance. Equation for net acid excretion. Bicarbonate reabsorption. Secretion of H^+ and manufacture of bicarbonate. Urinary buffers and excretion of acid as titratable acid and ammonium. Renal response to acidosis and alkalosis.

LABORATORY REGULATIONS AND BEHAVIOUR

Health and Safety is a primary concern for both students and staff working in any laboratory.

The following regulations MUST be adhered to when participating in Physiology practical classes:

- Each practical class has a student risk assessment (SRA) and a student safe working procedure (SSWP) associated with it.
- The SRA identifies the hazards and risks associated with the particular practical and outlines appropriate controls that must be followed to minimize these risks. The SRA also lists the personal protective equipment (PPE) that students are required to wear for that class, emergency procedures and clean up and waste disposal instructions.
- The SSWP provides background information relating to the class and outlines the procedures to be carried out in that class.
- Students must read the practical notes and sign the SRA prior to commencing the class.
- In each laboratory there are also more comprehensive school approved risk assessments, associated safe work procedures and safety data sheets (SDS) for each particular class. You may refer to these if you require further information. First aid kits and specific spill kits are also located in the laboratories.
- If any accidents or incidents occur they should be reported immediately to the demonstrator in charge of the class who will record the incident and recommend what further action is required.
- Random tests will be given throughout the session prior to the class, to encourage adequate preparation by the students. The results of these tests will contribute 10% of your assessment for the session.
- Students are required to wear the appropriate PPE for each class. Enclosed shoes are mandatory for entering any laboratory (other than computer classes) and you will not be permitted to participate in the practical if you are not wearing appropriate footwear. Most practical classes will also require a lab coat which you must provide. You must regularly wash your lab coat. If you do not bring your lab coat to these classes you will not be able to participate.
- Many classes will require you to wear gloves (which will be provided). Gloves must be removed before writing in lab books and using computers or other electrical equipment.
- You must not wear lab coats or gloves outside the laboratory.
- You must not eat or drink in any laboratory.
- Students are expected to arrive on time. Any student arriving more than 10 minutes late may be refused entry.
- Mobile phones should be turned off before entering the class.
- Laboratory computers may only be used for work relating to the practical class.
- It is expected that students behave appropriately in laboratory classes. In the event of inappropriate behaviour students may be asked to leave.
- It is of course vital that animals used in practical classes MUST be treated humanely and with respect. Taking photos is **ABSOLUTELY UNACCEPTABLE**, and will result in removal from the class and a referral to the Head of Department.

The procedures used in the laboratory classes involving the use of animals have been approved by the UNSW Animal Ethics Committee (ACEC 13/66B expiring 10/6/16).

Experiments in this manual, which involve the use of human subjects, have been considered and approved by the School of Medical Sciences Ethics Committee on Experimental Procedures Involving Human Subjects for teaching. Practical classes involving your participation as a subject may require you to sign a witnessed, informed consent form.