



THE UNIVERSITY OF
BUCKINGHAM

MEDICAL SCHOOL

MB ChB

Unit Summary: Metabolism

1 *Educational Aims of the Unit*

The unit aims to enable students to make progress towards meeting some of the learning outcomes described in Tomorrow's Doctors (2009) relevant to 'The Doctor as a Scholar and Scientist' and 'The Doctor as a Professional'. The specific aim is to enable students to develop an understanding of the tissue metabolism and the chemical processes which go on within cells in order to maintain their proper function, and how these are controlled by the endocrine system. You will consider how these processes are controlled and what happens when this control breaks down. There are three major areas of study and at all stages clinical presentations that arise as a consequence of metabolic or hormonal disorders will be discussed.

- Nutrition and whole body metabolism, considers the energy and nutrient requirements of the whole body, along with the regulation of body weight.
- Cellular metabolism, considers the chemical reactions and transformations that go on inside cells and tissues, and how they are controlled.
- Endocrinology, considers how the metabolism of cells and tissues is integrated to serve the needs of the whole body under different physiological conditions.

2 *Learning Outcomes From Tomorrow's Doctors (2009)*

Outcomes 1: The Doctor as a Scholar and Scientist.

8. The graduate will be able to apply to medical practice biomedical scientific principles.
 - a) Explain normal human structure and functions.
 - b) Explain the scientific bases for common disease presentations.
 - c) Justify the selection of appropriate investigations for common clinical cases.
 - d) Explain the fundamental principles underlying such investigative techniques.
 - e) Select appropriate forms of management for common diseases, and ways of preventing common diseases, and explain their modes of action and their risks from first principles.
 - g) Make accurate observations of clinical phenomena and appropriate critical analysis of clinical data.
11. Apply to medical practice the principles, method and knowledge of population health and the improvement of health and healthcare.
 - g) Recognise the role of environmental and occupational hazards in ill-health and discuss ways to mitigate their effects.
 - h) Discuss the role of nutrition in health.
12. Apply scientific method and approaches to medical research.
 - a) Critically appraise the results of relevant diagnostic, prognostic and treatment trials and other qualitative and quantitative studies as reported in the medical and scientific literature.
 - b) Formulate simple relevant research questions in biomedical science, psychosocial science or population science, and design appropriate studies or experiments to address the questions.
 - c) Apply findings from the literature to answer questions raised by specific clinical problems.

Outcomes 3: The Doctor as a Professional

20. The graduate will be able to behave according to ethical and legal principles. The graduate will be able to:

e) Recognise the rights and the equal value of all people and how opportunities for some people may be restricted by others' perceptions.

21. Reflect, learn and teach others.

b) Establish the foundations for lifelong learning and continuing professional development, including a professional development portfolio containing reflections, achievements and learning needs.

c) Continually and systematically reflect on practice and, whenever necessary, translate that reflection into action, using improvement techniques and audit appropriately for example, by critically appraising the prescribing of others.

d) Manage time and prioritise tasks, and work autonomously when necessary and appropriate.

e) Recognise own personal and professional limits and seek help from colleagues and supervisors when necessary.

3 Teaching and Learning Strategies

Principles will be introduced in formal lectures, and learning will be reinforced in personal diaries and facilitator led small-group work immediately afterwards. Students will work in the same teams throughout Phase I to encourage team-working. Some concepts will be discussed in more detail in Moodle- based tests and coursework which will allow for formative assessment. Students will be provided with workbooks describing structured tasks to direct independent learning throughout the unit, and the ongoing use of an e-portfolio will nurture and encourage reflective practice.

4 Unit Outline/Syllabus

Session 1: Nutrition, body weight, homeostasis

Lecture: Introduction, nutrition, diet, body weight,

Small Group Work: Diet analysis, diet diary, eat well plate

Lecture: Energy reactions in cells, cell metabolism

Self Directed Learning: Diet diary, case study on BMI, obesity, malnutrition and undernutrition

Session 2: Cell metabolism, carbohydrate metabolism

Lecture: Energy production (carbohydrate 1)

Small Group Work: Case study: BMI, obesity, malnutrition, undernutrition

Lecture: Energy production (carbohydrate 2)

Self Directed Learning: Case study of galactosaemia

Session 3: Carbohydrate metabolism, lipid metabolism

Lecture: Energy production (carbohydrate 3)

Small Group Work: Case study of galactosaemia

Lecture: Energy production (lipids)

Self Directed Learning: Case study G6PD deficiency

Session 4: Energy storage

Lecture: Energy storage (carbohydrates, lipids)

Small Group Work: Case study of G6PD deficiency

Lecture: Energy storage (proteins)

Self Directed Learning: Amino acid metabolism

Session 5: Lipid transport, byproducts of energy production

Lecture: Lipid transport

Small Group Work: PKU, Case study amino acid metabolism

Lecture: Byproducts of energy production

Self Directed Learning: Case study hyperlipidemia and hypercholesterolemia

Session 6: Drug metabolism, review of metabolic pathways

Lecture: Drug metabolism

Small Group Work: Hyperlipidaemia, hypercholesterolaemia.

Lecture: Review of metabolic pathways

Self Directed Learning: Case study hypoglycemia and glycogen storage diseases

Session 7: Endocrine pancreas

Lecture: Homeostasis & Introduction to the Endocrine System

Small Group Work: Case study hypoglycemia and glycogen storage diseases

Lecture: Control of appetite, metabolic syndrome

Self Directed Learning: Diabetes mellitus

Session 8: Diabetes

Lecture: Clinical presentation of Diabetes mellitus

Small Group Work: Case studies of diabetes

Lecture: Hormones of the Endocrine Pancreas and the Control of Metabolism.

Self directed Learning: Diabetes mellitus

Session 9: Hypothalamic pituitary axis

Lecture: Clinical presentation: disorders of the pituitary gland

Small Group Work: Case study of adrenal dysfunction

Lecture: Disorders of the adrenal cortex

Directed Learning: pituitary adrenal axis

Session 10: Thyroid glands

Lecture: The thyroid hormones

Small Group Work: Case study of thyroid dysfunction

Lecture: Clinical presentation on the disturbances to thyroid function

Self Directed Learning: clinical studies on thyroid function

Session 11: Calcium metabolism and the pituitary gland

Lecture: Control of calcium

Small Group Work: Case study on calcium metabolism

Lecture: Adaptations of metabolism

Self Directed Learning: Clinical studies on adaptive metabolism

Session 12: REVISION WEEK

5 Secondary Learning Outcomes

In addition to meeting the outcomes described in Tomorrow's Doctors, at the completion of the unit students will be able to:

- List the essential components of the human diet and explain why they are essential.
- Calculate Body Mass Index and describe the factors involved in the long-term regulation of body weight.
- Define homeostasis and discuss control systems in the body.
- Explain how the energy required for cellular activity is derived from the food eaten.
- Describe the general features and clinical relevance of the metabolic pathways by which carbohydrates, lipids, amino acids and alcohol are oxidised and may be synthesised from appropriate precursors.
- Outline the pathways involved in drug metabolism.
- Describe the metabolic problems of anaerobic conditions and explain their clinical consequences.
- Describe in outline how glucose and lipids are transported and stored in the body and explain the clinical consequences of defects in these pathways.
- Describe how and why ketone bodies are produced and explain the clinical importance of these molecules.
- Analyse simple clinical case histories involving disturbances to metabolism such as marasmus, kwashiorkor, obesity, galactosaemia, glucose 6-phosphate dehydrogenase deficiency, hypercholesterolaemia, phenylketonuria, homocystinuria, glycogen storage diseases, and hypoglycaemia.
- List the major metabolic activities of the following: central nervous system, liver, heart muscle, skeletal muscle, adipose tissue, red blood cells.
- Describe in outline the structures, functions, modes of action and the control of secretion of the major hormones involved in the control of metabolism.
- Describe in outline the metabolic changes that occur during feeding, fasting, starvation, pregnancy and exercise and explain how they are controlled.
- Explain why the blood glucose concentration is normally held relatively constant and explain the metabolic and clinical consequences of untreated type 1 and type 2 diabetes. Analyse simple clinical case histories involving disorders of the thyroid, pituitary and adrenal glands.

6 Key Texts and/or Other Learning Materials

- *Medical Biochemistry*, 4th Edition, by J.W. Baynes & M.H. Dominiczak. (Elsevier; 2014).
- *Biochemistry*, 5th Edition, by Harvey and Ferrier (Lippincott, Williams & Wilkins 2010).
- *Ganong's Review of Medical Physiology*, 25th Edition, by K. E. Barrett, S. M. Barman, S. B. Hedden Brooks (McGraw-Hill; 2015).
- *Medical Physiology*, 2nd Edition, by W. F. Boron and E. L. Boulpaep (Saunders; 2012).
- *Lippincott's Illustrated Reviews: Physiology*, by Preston and Wilson (LWW 2013).
- *Clinical Medicine*, 7th Edition, by Kumar and Clark (Saunders; 2009).



- *The Endocrine System*, 2nd Edition, by J. Hinson, P. Raven, and S. Chew (Churchill Livingstone; 2010).

Document Version Information

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