



Faculty of Health Sciences

School of Human Physiology and Anatomy

HBS1HRB

Regulation of Human Body Function

Semester 2

2008

STUDENT MANUAL

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LA TROBE UNIVERSITY
SCHOOL OF HUMAN PHYSIOLOGY AND ANATOMY

HBS1HRB Regulation of Human Body Function

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INTRODUCTION

Welcome to the unit *HBS1HRB Regulation of Human Body Function*.

This student manual contains information which has been developed as an aid to your participation and learning in the unit. The lecture timetable, outlines and associated material provide both an overview of the unit and aids to study.

The practical class activities are an integral part of the teaching in HBS1HRB, providing you with opportunities to learn new material, in a way that enables you to gain new skills, and that is enjoyable.

Lecture outlines, objectives and study questions are for your use in private study and for use in practical classes and tutorials.

UNIT AIMS

The general aim of this unit is to develop and extend aspects of both cellular and whole body structure and function that were introduced in semester one.

Specific aims are to:

- continue the study of the organisation and function of living things with a comparison of prokaryotic and eukaryotic organisms, illustrating aspects of this with a consideration of body defences and responses to infection
- develop concepts of physiological chemistry, with an emphasis on energy transformations in the cell
- explain the organisation, expression and roles of genes in cell and tissue physiology, and to discuss the mechanism of protein synthesis in mammalian cells
- discuss human patterns of inheritance
- discuss integrative processes within the body with illustration by several examples from anatomy and physiology, including the nervous and reproductive systems.

This unit is one of the foundation studies in the Bachelor of Health Sciences degree, and as such, provides education in areas that underpin many graduate skills. This unit offers students the opportunity to gain expertise to:

- describe and explain aspects of cellular and whole body structure and function
- interpret and evaluate information related to the unit, including not only some of the scientific literature, but also “information” from the various media
- select and apply relevant information for purposes of personal health promotion
- discuss selected areas of experimental cellular and whole body physiology, identifying potential ethical ramifications of these areas
- access in its various forms information relevant to the unit

- use a variety of techniques in the study of cellular and whole body physiology
- become a life-long self-directed learner.

UNIT ASSESSMENT

This unit is assessed by one examination and three tests. Each of the three practical classes has a short test based on material presented in the class.

The examination contributes 80% of the final mark for the unit and is held during the examination period at the end of the semester. This examination comprises 120 multiple choice questions (MCQs). The MCQs are of two different types – see below.

The three tests contribute 20% of the final mark and are normally held at the end of each practical class.

NB if you do miss a practical class for a valid reason (eg illness), please give a completed form, plus relevant documentation, to Elizabeth Brown. A copy of the form ‘Absence from a practical class’ can be found at this at the end of this manual. If you miss a class for no valid reason, you are not permitted to sit for the test, and so you will forfeit the marks for that test.

TEXTBOOK REFERENCE

The prescribed textbook for the unit is: Marieb, EN and Hoehn, K 2007. *Human Anatomy and Physiology*, 7th ed. Pearson.

LECTURE RESOURCES

- Copies of the powerpoint slides from the lecture presentations will be available on the WebCT site for this unit.
- **These resources should be seen as a *guide* to unit content and should not be relied upon as the main resource - the lectures are the best guide to unit content.**
- It is an advantage for students to develop note-taking skills: this should help to focus on the lecture content, and should also help with understanding and memorisation of the material.

COMMUNICATION: LECTURING STAFF & CONTACT DETAILS

Name	Room	Phone	email
Professor Chris Handley	HS2 324	9479 5800	c.handley@latrobe.edu.au
Elizabeth Brown	HS2 443	9479 5869	e.h.brown@latrobe.edu.au
Dr Johannes Schuijers	HS2 426	9479 5843	j.schuijers@latrobe.edu.au
Dr Andrew Bendrups	HS2 421	9479 5756	a.bendrups@latrobe.edu.au
Reception	HS1 level 1	9479 1750	

Tutors and demonstrators are Brianna Julien, Richard Wilkins, Tom Samiric and John Parkinson.

Professor Chris Handley and Elizabeth Brown are the unit coordinators. Please see Elizabeth Brown in the first instance for any *administrative matters* for the unit.

If you would like to discuss aspects of the *content* of the unit, the staff would be pleased to do so. It is wise to make an appointment, however.

COMMUNICATION: PHYSIOLOGY NOTICE BOARD

You will be advised about use of WebCT in this unit during the semester.

Information such as unit timetable and practical/tutorial class groups will be placed on the Physiology noticeboard. This noticeboard is located in the corridor of HS2 Level 2 between Rooms 223 and 226 (outside room 224).

MULTIPLE CHOICE QUESTION INSTRUCTIONS

Some study questions are in the form of multiple choice questions (MCQs). The purpose of these MCQs is to stimulate your thinking about the topic, and to give you some experience at attempting to answer questions of these types. Two types of questions have been used – these are the ones you are most likely to have in examinations.

The two styles of directions are as follows:

a. b. c. d. e.

For each of the questions or incomplete statements only one of the following is correct.

Select the ONE response which is BEST or MOST APPROPRIATE in each case.

The body consists of:

- a. cells
- b. tissues
- c. organs
- d. organ systems
- e. all of the above

(answer: e)

W. X. Y. Z.

For each of the questions or incomplete statements, ONE or MORE of the suggested answers given is correct.

- | | | |
|---------------|----------|---------------------------------------|
| Answer | a | if only W, X and Y are correct |
| | b | if only W and Y are correct |
| | c | if only X and Z are correct |
| | d | if only Z is correct |
| | e | if all are correct. |

Lecturing staff in HBS1HRB include:

- W. Professor Chris Handley
- X. Elizabeth Brown
- Y. Dr Johannes Schuijers
- Z. Dr Andrew Bendrups

(answer: e, because all of W, X, Y & Z are correct)

SOME ADVICE FROM PREVIOUS STUDENTS

At the end of teaching in previous years, students have been asked “*What suggestions would you give to future students to help their learning?*”

The commonest responses are included here to help you with “Regulation of Human Body Function” in 2008.

Study regularly - revise after every lecture - do further reading.

Keep up to date with the objectives – do the objectives every week.

Take advantage of tutorials - ask questions if you don't understand something.

Take advantage of practical classes - attend the practical classes.

Attend all lectures and listen.

Contact the lecturer if unsure about something.

“Take it a bit at a time. Study throughout the year as this is a unit which requires a lot of study.”

“Do not only attend lectures, pracs and tutes – take advantage of all that these offer”. “Tutorials helped to link and explain ideas. They made it enjoyable to learn.”

Quite a few students said that tutorials were so helpful they should be compulsory!

**LA TROBE UNIVERSITY
SCHOOL OF HUMAN BIOSCIENCES**

HBS1HRB Regulation of Human Body Function

**LECTURE OUTLINES, OBJECTIVES,
REFERENCES & STUDY GUIDES**

LECTURE OUTLINES

Lecture 1: Introduction to the unit

Unit 1: CELLULAR PHYSIOLOGY – ORGANIZATION OF LIVING ORGANISMS

Lecture 2 & 3 Organization of mammalian cells

Relative sizes of mammalian cells, bacteria and viruses.
 Limitation in size of mammalian cells.
 Structure of mammalian cells.
 Nature of cell membranes, types of cellular junctions.
 Cell organelles and their role in mammalian cells.
 Specialization of mammalian cells.

Lecture 4 Structure of bacteria

Structure of bacteria.
 Bacterial membrane and cell wall; gram positive and gram negative bacteria.
 Bacterial replication.
 Bacteria and disease.

Lecture 5 Structure of viruses

Major features of viruses.
 Classification of viruses.
 Virus replication.
 Viruses and disease.

Lecture 6 & 7 Defenses of the human body to infection

Non-specific defenses to infection, physical barriers, the inflammatory response, complement and interferon.
 Specific defenses to infection, antibodies and killer cells.

Objectives

Structure of mammalian cells, bacteria and viruses

1. The relative sizes of mammalian cells, bacteria and viruses, and factors limiting the size of mammalian and bacterial cells.
2. The nature of biological membranes and junctions between cells. The organization and role of the nucleus, endoplasmic reticulum/Golgi apparatus and mitochondria in mammalian cells.
3. The different types of tissues and state the roles they play in the body.
4. The structure of bacteria and the difference between gram positive and negative bacteria. How bacteria affect the physiology of the human body.
5. The structure of viruses and how viruses use mammalian cells for replication.

Defenses of the human body to infection

1. How the skin and mucous membranes act as non-specific defenses to bacteria and viruses, and the role of inflammation in controlling infection.
2. How antibodies specifically target bacteria and viruses, and cells that are infected by these micro-organisms.

Study questions

1. Describe the cellular organization of mammalian cells. In your answer state what function cell organelles have.
2. List the major types of tissues that are found in the mammalian body and explain their roles.
3. Which is/are true for most bacteria? Bacteria:
 - W. do not have intracellular organelles.
 - X. have a strong cell wall.
 - Y. may have flagella.
 - Z. have intracellular organelles.
4. Which is/are true of viruses? Viruses:
 - W. contain only nucleic acids surround by a lipid membrane.
 - X. require a host cell for reproduction.
 - Y. will only infect particular types of cell.
 - Z. will kill any infected cell.

References

Organization of mammalian cells

Marieb, EN and Hoehn, 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 3 pp65-71, 84-90. Pearson.

Specialized role of cell in the human body

Marieb, EN and Hoehn, K2007 *Human Anatomy and Physiology*, 7th ed. Chapter 4 pp118-144. Pearson.

Organization of bacteria and bacterial infections

Campbell, Biology, 4th edition. Chapter 25, pp 498-506.

Viruses and infection

Campbell, Biology. 4th edition. Chapter 17, pp 324-334.

Response of human body to infection.

Marieb, EN ans Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 21 789-818. Pearson.

Unit 2: CELLULAR PHYSIOLOGY – METABOLISM

Lecture 8 Metabolic pathways and biological reactions

Role of metabolic pathway in the production of energy.
Metabolic pathways and biological reactions.
Energy and biological pathways.

Lecture 9 Enzymes

The nature of enzymes and role of enzymes in biological reactions.
Co-factors and co-enzymes.
Enzyme inhibition and regulation.

Lecture 10 Generation of cellular energy

The role of the glycolytic pathway, tricarboxylic acid pathway and electron transport chain in generation of ATP.

Lecture 11 Energy generation by cells under aerobic and anaerobic conditions

Aerobic and anaerobic generation of ATP.
Lactic acid and the Cori cycle.

Lecture 12 Energy generation from fats and proteins

Oxidation of fatty acids, protein catabolism, urea cycle.

Lecture 13 Cellular storage of energy

Synthesis of fatty acids and glycogen.

Objectives

1. Role of metabolic pathways in the production of energy. Biological reactions.
2. Nature and role played by enzymes in biological reactions. Nature of co-factors and co-enzymes. Enzyme inhibition and regulation.
3. The role of the glycolytic, and tricarboxylic acid pathways and the electron transport chain in the generation of energy.
4. Aerobic and anaerobic generation of energy. Lactic acid and the Cori cycle.
5. Generation of energy from fats and proteins. Role of the urea cycle.
6. Cellular storage of energy. The synthesis of fatty acids and glycogen.

Study questions

1. Describe the role played by enzymes in biological reactions.
2. How do cells generate energy in the absence of oxygen?
3. Which of the following is/are true about metabolic pathways?
 - W. Metabolic pathways consist of a number of biological reactions.
 - X. Only one enzyme is responsible for the catalysis of all the reactions that make up a pathway.
 - Y. Each reaction of a metabolic pathway is catalyzed by a specific enzyme.
 - Z. All metabolic pathways require an input of energy in the form of ATP.
4. Where is the electron transport chain located within mammalian cells?
 - a. Mitochondria
 - b. Cytoplasm
 - c. Lysosomes
 - d. Nucleus
 - e. Cell vacuoles

References

Metabolic pathways and biological reactions

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 24 pp956-989. Pearson.

Enzymes

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 2 pp53-54. Pearson.

Unit 3a: MOLECULAR PHYSIOLOGY–GENES AND PROTEINS

Lecture 14 Structure of nucleic acids

Concept of genes and the flow of genetic information.

Involvement of DNA and RNA in protein synthesis.

Structure of DNA, organization of DNA in the nucleus.

Structure of RNA, major types of RNA messenger RNA, transfer RNA and ribosomal RNA.

Lecture 15 The genetic code

Properties of the genetic code.

Features of a gene.

DNA replication, DNA polymerase. DNA repair processes.

Lecture 16 Mutations

Causes and types of mutations. Genetic diseases.

Objectives

1. Compare and contrast the structure of DNA and RNA.
2. Describe the process of DNA replication. Explain the importance of this process.
3. Explain how genetic information is coded in DNA and outline the properties of the code.
4. Summarize the direction of information flow during protein synthesis.
5. Explain what a mutation is.
6. Explain how a point mutation or the deletion or insertion of a base can affect the functioning of a protein.

Study questions

1. Part of the base sequence of a gene coding for a polypeptide is CTACCGCTAG. Predict;
 - a. The base sequence in the corresponding strand of DNA.
 - b. The base sequence of the mRNA transcribed from this region.
2. What are the three major types of RNA and what are their functions?
3. What is the difference between a codon and an anticodon?
4. Draw a diagram of a typical mammalian gene showing the internal structure and the control regions.

References

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 2 pp 54-57, Chapter 3 pp95-111. Pearson.

Unit 3b: MOLECULAR PHYSIOLOGY–GENES AND PROTEINS

Lecture 17 **Protein synthesis – transcription**

Formation of mRNA, RNA polymerase.
Processing of mRNA, introns and exons

Lecture 18 **Protein synthesis – translation**

Ribosome structure, structure of tRNA. Process of translation.
Folding of completed proteins.

Lecture 19 **Protein synthesis –post-translation events**

Protein trafficking.
Synthesis of secreted proteins and proteins destined for secretion; the involvement of endoplasmic reticulum and Golgi apparatus.
Post-translational modifications of proteins, addition of carbohydrate groups and proteolytic modification.

Lecture 20 **Control of gene expression**

Cell differentiation.
Control of transcription.
Control of translation and post-translational modifications of proteins.

Lecture 21 **Gene technology and therapy**

(this lecture will be given after Lecture 23)

Cloning of genes to give specific proteins.
Cloning of whole animals.
Transgenic and knockout animals.
Genes and forensic science.
Gene therapy and stem cell technology.

Objectives

1. Compare and contrast the structure of DNA and RNA.
2. Describe the process of DNA replication. Explain the importance of this process.
3. Explain how genetic information is coded in DNA and outline the properties of the code.
4. Summarize the direction of information flow during protein synthesis.
5. Explain what a mutation is.
6. Explain how a point mutation or the deletion or insertion of a base can affect the functioning of a protein.
7. Distinguish between gene transcription and translation.
8. Discuss the initiation of transcription in terms of RNA polymerase and the promoter region of a gene.
9. Explain how mammalian cells modify mRNA after transcription prior to passage of mRNA into the cytoplasm.
10. Describe the roles of mRNA, tRNA and rRNA in protein synthesis.
11. Explain the function of the signal sequence in the synthesis of a secreted protein.
12. Describe the major post-translational modifications that can occur to a protein and where they occur in the mammalian cell.
13. Explain differentiation in terms of gene expression.
14. Understand the major points of control of gene expression.
15. Label a diagram which illustrates the structure of a typical mammalian gene, showing the enhancer, promoter, introns, exons and termination sites.

16. Understand the concept of cloning genes to give specific proteins.
17. Describe the difference between a transgenic and knockout animal.
18. Describe the role of restriction endonucleases in DNA technology.

Study questions

1. Part of the base sequence of a gene coding for a polypeptide is CTACCGCTAG.
Predict:
 - a) The base sequence in the corresponding strand of DNA.
 - b) The base sequence of the mRNA transcribed from this region.
2. What are the three major types of RNA and what are their functions?
3. What is the difference between a codon and an anticodon?
4. Draw a diagram of a typical mammalian gene showing the internal structure and the control regions.
5. Discuss the control of gene expression at the level of transcription.
6. The RNA species that carries the coded message specifying the sequence of amino acids for a protein to be synthesised by a cell, from the nucleus to the cytoplasm is:
 - a. mRNA
 - b. tRNA
 - c. rRNA
 - d. all of the above.
7. The RNA synthesized on one of the DNA strands is:
 - a. mRNA
 - b. tRNA
 - c. rRNA
 - d. all of the above.

References

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 2 pp 54-57, Chapter 3 pp95-111. Pearson.

Unit 4: GENETICS

Lecture 22 **The cell cycle and cell division**

Phases of the cell cycle.

Mitosis.

Functions of mitosis and cell division.

Control of cell division.

Lecture 23 & 24 **Patterns of human inheritance**

Genes and chromosomes.

Karyotype.

Genetic variation: genes and alleles, genotype and phenotype.

Multiple alleles and gene expression.

Types of genetic diseases: single-gene disorders, chromosome disorders, multi-factorial disorders, mitochondrial disorders.

Lecture 25 **Human pedigrees**

Clinical examples of patterns of inheritance: autosomal and X-linked inheritance.

Genetics and society: selected social and ethical implications of modern genetics.

Objectives

The cell cycle and cell division

1. Explain what is meant by the cell cycle, including what is meant by each of the phases of the cell cycle.
2. Explain how mitosis is related to the cell cycle.
3. Explain why it is necessary that mitosis occurs in the body.

Patterns of human inheritance; human pedigrees.

4. Explain what is meant by an inherited characteristic.
5. Explain what is meant by a person's karyotype.
6. Distinguish between a gene and a chromosome.
7. Distinguish between a gene and an allele.
8. Explain what a pedigree is, and how it is a useful tool in medical genetics.
9. Explain the concept of dominant and recessive traits.

Study questions

The cell cycle and cell division

1. Explain why it is important that cell division is regulated in the body.
2. Metaphase is best described as that phase of mitosis when the:
 - a. chromatin condenses into chromosomes.
 - b. nuclear envelope breaks down.
 - c. chromosomes line up randomly along the midline of the cell.
 - d. centromeres divide in two.
 - e. cytoplasm divides in two.

3. Normal growth and development of tissues includes which of the following growth processes?
- Increases in cell numbers.
 - Increases in cell size.
 - Replacement of one tissue type by another tissue type.
 - Death of cells.
 - All of the above.

Patterns of human inheritance; human pedigrees.

4. A human karyotype normally consists of an array of:
- paired genes.
 - 22 pairs of autosomes plus the 2 sex chromosomes.
 - a total of 23 chromosomes.
 - paired strands of nuclear protein.
 - paired co-dominant alleles.
5. A Punnett square is useful for predicting:
- environmental effects on a phenotype.
 - percentage chance that offspring of affected or carrier parents will have a recessive trait.
 - polygenic inheritance.
 - multiple phenotypic effects from a single gene.
 - sex-linked inheritance.
6. Explain why the carrier of an inherited disease or condition must be heterozygous for that disease or condition.
7. Explain why a person's genotype cannot always be predicted from his/her phenotype.

Reference

The cell cycle and cell division

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 3 98-103; relevant parts of pp104-112. Pearson.

Patterns of human inheritance

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 29 pp1145-1159. Pearson.

Human pedigrees

Unit 6: THE BRAIN – CELLULAR ASPECTS OF CENTRAL NERVOUS SYSTEM STRUCTURE AND FUNCTION

- Lecture 26** **Cell Development and Cell Death**
 Embryonic development of the brain
 Neural stem cells
 Cellular differentiation
 Types of cells in the brain
 Congenital abnormalities
- Lecture 27** **Cell Development and Cell Death**
 Cell death
 Apoptosis versus necrosis
 Dementia
 Alzheimers disease
 Parkinsons disease
- Lecture 28** **Cell Development and Cell Death**
 Cellular regeneration: peripheral versus central nervous system
 Neurotrophins
- Lecture 29** **Reflexes and Central pattern generators**
 Definition of “reflex” and “reflex arc”
 Simple reflexes and their functions:
 1. Muscle stretch reflex
 2. Withdrawal (flexor) reflex
 3. Pupillary reflex
 Simple 2-cell central pattern generator (CPG)
 Roles of CPGs in animal behaviour:
 1. Locomotion
 2. Breathing rhythms and their modulation
- Lecture 30 & 31** **Cellular basis of learning and memory**
 Definitions of “learning” and “memory”
 Concept of synaptic plasticity
 Physiological basis of memory storage:
 1. “Reverberating” circuits
 2. Functional (temporary) changes in synapses
 3. Morphological changes (e.g. “remodeling” of synapses)
 Post-tetanic facilitation
 Long-term potentiation (LTP)
- Lecture 32** **Neural networks**
 Structure of a basic neural network
 Synaptic “weights” and their role in network function
 Functions of artificial neural networks
 Biological neural networks, memory and motor learning

Objectives

The Central Nervous System: Cell Development and Cell Death

1. Name the primary brain vesicles.
2. Name the secondary brain vesicles and indicate the resultant brain regions at birth.
3. State the functions of the main cell types found in the brain.
4. Explain the difference between apoptosis and necrosis of nerve cells.
5. If symptoms characteristic of Parkinson's disease appear, what part of the brain is inhibited from secreting which neurotransmitter?
6. Discuss the major brain changes that commonly are associated with Alzheimer's disease.
7. Describe the process of nerve regeneration and compare and contrast the process in the peripheral and central nervous systems.

Reflexes and central pattern generators

1. Explain how small groups of neurones are able to produce simple responses to a sensory stimulus, using a typical "reflex arc" as an example (e.g. stretch reflex, withdrawal reflex).
2. Draw a neural circuit diagram of a simple 2-cell rhythmic central pattern generator (CPG) and explain how it works.
3. Outline the general roles of reflexes and CPGs in the human nervous system.

Cellular basis of learning and memory

1. Define the term "synaptic plasticity".
2. Explain how memory storage is thought to occur at a cellular level. Explain the difference between "functional" and "morphological" synaptic changes and outline their likely roles in memory storage.
3. Explain the terms "post-tetanic facilitation" and "long-term potentiation" (of synapses).

Neural networks

1. Describe the basic structure of a three-layered neural network.
2. Describe the sorts of things that an artificial neural network can be trained to do.
3. Explain how neural networks might be able to generate new stimulus-response sequences in biological systems.

Unit 6: THE BRAIN – INTEGRATED ASPECTS OF CENTRAL NERVOUS SYSTEM STRUCTURE AND FUNCTION

Lecture 33

Cortical topography

The cerebral cortex
cerebral landmarks and lobes
motor and sensory areas of the cortex
The corpus callosum
The meninges

Lecture 34

Diencephalon and Brain Stem

The diencephalon
thalamus
hypothalamus
The brain stem
pons
medulla oblongata
midbrain

Lecture 35

Accessory structures

The basal ganglia
The cerebellum
The limbic system
The ventricles

Lecture 36

Protection and Support

The blood brain barrier
Cerebral blood supply
oxygen requirements
metabolism
regional blood flow
Electroencephalogram

Lecture 37

Higher brain functions: human memory

Declarative and procedural memory
Short-term memory (STM) and long-term memory (LTM)
Concept of memory consolidation
Functional anatomy of human memory:
1. Association cortex
2. Hippocampus
3. Amygdala
4. Cerebellum (procedural memory)
Amnesia: retrograde and anterograde

Lecture 38 **Higher brain functions: emotion and motivation**

Motivation and emotion in animal behaviour

Brain structures involved in emotion (“limbic system”):

1. Hypothalamus
2. Amygdala
3. Septal nuclei
4. Cingulate gyrus

Effects of injury or abnormal stimulation

Objectives

Cortical topography

1. Name the lobes of the cerebral cortex.
2. State the function of the corpus callosum.
3. Name the layers of the meninges.
4. What kinds of problems are associated with the presence of lesions in Wernicke’s and Broca’s areas?
5. What is a motor homunculus? How does it differ from a sensory homunculus?

Diencephalon and Brain Stem

1. State the role of the thalamus.
2. Describe four functions of the hypothalamus.
3. State the major roles of each of the various aspects of the brainstem.

Accessory structures

1. Name the ventricles and describe their function.
2. Describe four important functions of the CSF?
3. Briefly summarize the overall function of the cerebellum.
4. Where is the limbic system located and what is its major function?

Protection and Support

1. Discuss the function of the blood-brain barrier.
2. Name the major vessels that supply blood to the brain.
3. What brain states do each of the brain waves represent?

Human memory

1. Explain the differences between declarative memory and procedural memory.
2. Describe the characteristics, in behavioural terms, of short-term and long-term human memory.
3. Explain what is meant by “memory consolidation”.
4. Outline the likely roles of the hippocampus and association cortex in long-term memory formation and storage.
5. Distinguish between retrograde and anterograde amnesia by describing the sorts of memory (and social) problems someone with each disorder might exhibit.

Emotion and motivation

1. Explain the role of emotion and motivation in animal behaviour.
2. Describe the possible behavioural effects of injury to the amygdala, septal nuclei, or hypothalamus.

Study questions

1. Damage to the pre-central gyrus of the cerebrum might lead to:

- a. loss of sensation.
 - b. visual dysfunction.
 - c. loss of hearing.
 - d. loss of motor function.
 - e. speech comprehension impairment.
2. Layers of the meninges include the:
 - W. dura mater.
 - X. arachnoid mater
 - Y. pia mater.
 - Z. epidermis.
 3. Which of the following is/are function(s) of the hypothalamus?
 - W. Body temperature regulation
 - X. Endocrine control of the pituitary gland
 - Y. Regulation of water balance and thirst
 - Z. Hand-eye coordination
 4. The central nervous system is protected from damage by the:
 - W. cerebrospinal fluid.
 - X. meninges.
 - Y. blood-brain barrier.
 - Z. electroencephalographic activity.
 5. A patient has suffered a cerebral haemorrhage that has caused dysfunction of the post-central gyrus of his right cerebral cortex. As a result:
 - a. he cannot voluntarily move his right limb.
 - b. he feels reduced or no sensation on the left side of his body.
 - c. he feels reduced or no sensation on the right side of his body.
 - d. his speech is incomprehensible.
 - e. action potentials will not be transmitted along sensory neurones.
1. How does the stretch reflex work? What useful purpose does it serve?
 2. What sorts of behaviours are controlled by CPGs (and what behaviours are not)?
 3. Where is the respiratory CPG? Does it *depend* on sensory inputs? Do sensory inputs play *any* role in its function?
 4. How is “learning” different from “memory”? Can you have learning *without* memory?
 5. In storing memory, what sorts of changes occur at the level of the neurone? Are new neurones formed? Are memories stored as chemicals? Are memories stored as changes in synapses?
 6. What is a neural network? What can artificial neural networks do? What can biological neural networks do? What changes when a neural network is “trained”?
 7. What can happen to memory and emotion if the temporal lobe of the brain is damaged? What functions are carried out by structures in the temporal lobe?
 8. What does an animal do when placed in a novel environment? Does its behaviour change as it interacts with its environment? What is the role of reward and punishment in this process?

Case studies

1. A 75-year old man was admitted to hospital after suddenly losing consciousness at home. A week later he recovered consciousness but was having difficulty speaking and could not

move the right side of his body. He does however, suffer little motor deficit to his facial muscles. What do these signs and symptoms suggest is the problem?

2. A boxer lost consciousness after a heavy blow to the head. After a few minutes he recovered, only to complain of blurred vision. What may have caused his loss of consciousness and his visual impairment?
3. A psychology experiment asks the seated subject to press a button located on the left hand side of the desk upon hearing a buzzer. They are to do so as rapidly as possible. Based on your knowledge of brain function, describe the processes involved in undertaking this procedure.
4. A patient has been experiencing episodes of severe skeletal muscle spasms of the right leg and foot over a period of two years. His electroencephalogram (EEG) was recorded in a research unit. The EEG showed that the muscle spasms were associated with a marked change in EEG activity. Please explain.
5. A young child presented at hospital suffering many symptoms but including severe headache and fever. A lumbar puncture was performed. This showed elevated levels of white blood cell. Why was a lumbar puncture performed? What diagnosis does this result suggest?

References

Central cell death and growth factors

Lecture notes.

Brain development

Marieb, EN and Hoehn, K2007 *Human Anatomy and Physiology*, 7th ed. Chapter 12 pp 431-436. Pearson.

Reflexes

Marieb, EN and Hoehn, K2007 *Human Anatomy and Physiology*, 7th ed. Chapter 13 pp521-527; Chapter 15 p578. Pearson.

Central pattern generators

Marieb, EN and Hoehn, K2007 *Human Anatomy and Physiology*, 7th ed. Chapter 13 pp519-520. Pearson.

Cellular basis of learning and memory

Marieb, EN and Hoehn, K2007 *Human Anatomy and Physiology*, 7th ed. Chapter 12 pp460-463. Pearson.

Vander, AJ, Sherman, JH & Luciano D.S., 2001. *Human Physiology: The Mechanisms of Body Function*, 8th edition. Chapter 13 pp365-367. McGraw-Hill, New York

Neural networks

Lecture notes [based on Hinton, G.E., 1992. *How neural networks learn from experience*. Scientific American 267(3),105-109.]

Brain: Cortical topography

Brain: Diencephalon and Brain Stem

Brain: Accessory structures

Brain: Protection and Support

Marieb, EN and Hoehn, K2007 *Human Anatomy and Physiology*, 7th ed. Relevant parts of Chapter 12. Pearson.

Higher brain functions: human memory, emotion and motivation

Marieb, EN and Hoehn, K2007 *Human Anatomy and Physiology*, 7th ed. Relevant parts of Chapter 12. Pearson.

Vander, AJ, Sherman, JH & Luciano D.S., 2001. *Human Physiology: The Mechanisms of Body Function*, 8th edition. Chapter 13 pp 360-362; 365-367. McGraw-Hill, New York

Unit 5: REPRODUCTION - CELLULAR ASPECTS OF REPRODUCTION

Lecture 39 & 40 Meiosis and fertilization

Events and consequences of meiosis.
Spermatogenesis and oogenesis: an overview.
Events of fertilization.

Lecture 41 Early human development

The pre-embryo and implantation.
Differentiation and embryogenesis.
Pre-natal growth and development: the embryonic and fetal periods.
Stem cells (embryonic and adult).
Factors affecting pre-natal growth and development.

Lecture 42 Sex hormones throughout the lifespan

The sex hormones and their effects, especially sexual differentiation, puberty and adult reproductive function.
Patterns of sex hormone secretion throughout the lifespan.

Objectives

Cellular aspects of reproduction

1. Explain the process of meiosis.
2. Explain how sexual reproduction increases genetic diversity.
3. Describe the similarities and differences between spermatogenesis and oogenesis.
4. List the sequence of events of fertilization.
5. Describe early human development from zygote to implanted blastocyst.
6. Describe growth processes which contribute to embryogenesis.
7. Define the embryonic and fetal periods.
8. Explain what is meant by stem cells, distinguishing between embryonic and adult stem cells.
9. Describe the patterns of secretion of sex hormones throughout the lifespan of males and females.
10. Explain the consequences of changes that occur in sex hormone secretion at key stages of life.

Cellular aspects of reproduction

9. Teratogens:
 - a. commonly exert their effects during a sensitive period.
 - b. have been identified as the causes of all birth defects.
 - c. never exert any effects during the fetal period.
 - d. are all unavoidable.
 - e. do not include drugs in use therapeutically.
10. Sex hormones:
 - a. have effects on body structures and functions in addition to the reproductive systems.
 - b. are not secreted until maturation of the reproductive systems is complete.
 - c. are not secreted after an average age of 50 in both sexes.
 - d. are unimportant in the physiology of pregnancy.
 - e. are completely different in males and females.

SEX HORMONE EFFECTS

Effects of testosterone

1. spermatogenesis
2. feedback to the hypothalamus & anterior pituitary gland
3. somatic growth and development -
sexual differentiation - male pattern
puberty: accelerated somatic growth, including muscle and bone (causes cessation of bone growth); genital tract growth & maintenance; development and maintenance of secondary sexual characteristics
4. behaviour: libido, aggression (?)
5. stimulates erythropoietin secretion.

Effects of estrogen (oestrogen)

1. stimulates growth and maintenance of the reproductive tract
2. causes female pattern of fat deposition at puberty, hence female body shape
3. causes female pattern of pubic hair growth at puberty
pubic and axillary hair growth requires androgens
4. stimulates bone growth & calcium retention
is responsible for pubertal growth spurt and cessation of growth
5. has an 'anti-acne' effect
6. has effects on blood vessels
deficiency causes hot flushes
7. promotes a favourable plasma lipid profile
protects against atherosclerosis
8. stimulates growth of ovary and follicles
9. stimulates proliferation of the uterine endometrium, and 'layering' of the vaginal epithelium
10. stimulates secretion by mucus membranes
11. stimulates cervical secretion of 'fertile' mucus
12. has feedback effects on hypothalamus & anterior pituitary gland to stimulate or inhibit ovulation
13. stimulates breast growth - ducts and fat
14. causes retention of sodium ions and therefore fluid
15. inhibits milk secretion

Effects of progesterone

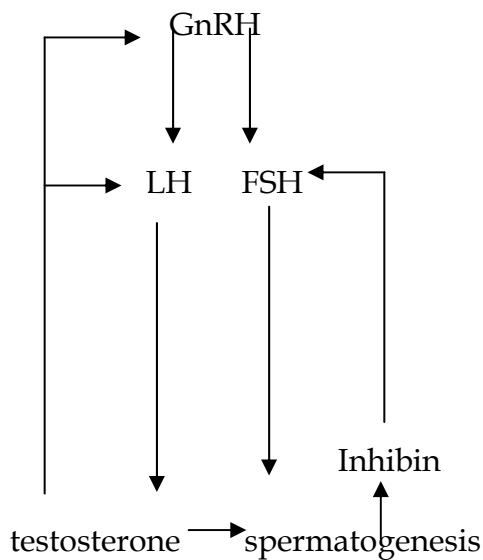
1. stimulates secretion (eg of glycogen) by the endometrial glands
2. causes cervical mucus to become thick and sticky; this results in formation of a mucus plug in pregnancy
3. decreases smooth muscle contractions, especially of the uterus
4. stimulates breast growth (glandular tissue)
5. inhibits milk secretion (inhibits the milk-secretion effects of prolactin)
6. has feedback effects on the hypothalamus & anterior pituitary
7. causes some elevation of metabolic rate hence basal body temperature (BBT)

HORMONAL REGULATION OF ADULT REPRODUCTIVE SYSTEM FUNCTION

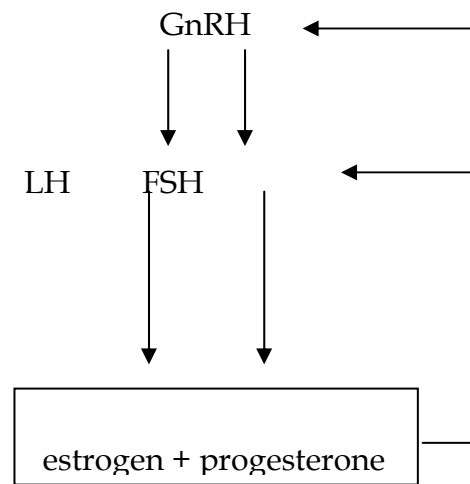
Hypothalamus	Gonadotrophin Releasing Hormone (GnRH)	
Anterior pituitary gland	Luteinising Hormone (LH) & Follicle Stimulating Hormone (FSH)	
Gonads	Testes	Ovaries
Adrenals	Testosterone Sex hormones	Estrogen & Progesterone Sex hormones

Add in negative feedback symbols:
Negative feedback control

MALE



FEMALE



Positive feedback control: FEMALE

LH - E -> LH E -> LH -> E -> LH

References

Meiosis and fertilization

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 27 pp1070-1074; 1088-1089. Pearson.

Early human development

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 28 pp1110-1119. Pearson.

Sex hormones throughout the lifespan

Marieb, EN and Hoehn, K 2007 *Human Anatomy and Physiology*, 7th ed. Chapter 27 pp1101-1108. Pearson.

Unit 7: REPRODUCTION - REGULATION OF THE REPRODUCTIVE SYSTEMS

Lecture 43 & 44 The adult reproductive systems

Male reproductive system structure and function: the gonads and associated structures.

Female reproductive system structure and function: the gonads and associated structures.

Lecture 45 The menstrual cycle

Ovarian and uterine events.

Hypothalamic and anterior pituitary gland regulation of ovarian function.

The menstrual cycle as a preparation for pregnancy.

Lecture 46 - 48 Pregnancy, childbirth and lactation

The physiology of sexual response.

Endocrinology of pregnancy.

Maternal physiological adaptations to pregnancy.

The events of labour.

The puerperium.

The physiology of breastfeeding.

Lecture 49 & 50 A review of the anatomy and physiology of the adult reproductive systems: family planning

Behavioural methods of family planning.

Barriers to gamete transport.

Hormonal and pharmacological contraception.

Theoretical methods of contraception.

Objectives

Regulation of the reproductive systems

1. Describe the function/s of the anatomical components of the male reproductive system.
2. Describe the function/s of the anatomical components of the female reproductive system.
3. Explain the events of the menstrual cycle in terms of ovarian events, the effects of the ovarian hormones on the uterus, and hormonal regulation of the cycle.
4. Describe a woman's hormonal responses to pregnancy.
5. List maternal physiological adaptations to pregnancy.
6. List the stages of labour in childbirth, and outline the events of each stage.
7. Explain how breastfeeding is usually able to meet all the fluid and nutrient requirements of the infant.
8. Explain why breastfeeding usually has health benefits for both mother and infant.
9. Explain how family planning can be achieved by each of the following methods: prevention of gametes meeting; suppression of availability of gametes; prevention of ongoing development of the conceptus.
10. Distinguish between method failure and user failure with respect to family planning techniques.

Study questions

Regulation of the reproductive systems

1. Compared with the 7th day of a normal 28 day menstrual cycle, on the 21st day there is a greater:
 - a. progesterone concentration in the blood.
 - b. thickness of the uterine endometrium.
 - c. basal body temperature.
 - d. store of nutrients in the endometrium.
 - e. all of the above.

2. Human Chorionic Gonadotrophin (hCG):
 - a. is secreted by the ovary.
 - b. is a precursor hormone for estrogen and progesterone.
 - c. may be detected in the urine during early pregnancy.
 - d. is required for ovulation to occur.
 - e. stimulates the secretion of milk.

3. Method failure for the combined oral contraceptive pill includes unplanned pregnancy in association with (for the woman):
 - a. an episode of vomiting or diarrhoea.
 - b. failure of suppression of ovulation by the estrogen and progesterone levels due to the combined oral contraceptive.
 - c. the presence of contraindications for the combined oral contraceptive pill.
 - d. concurrent use of another medication such as an antibiotic.
 - e. a forgotten pill, for the first or last pill of the pack.

References

The adult reproductive systems

Marieb, EN and Hoehn, K 2007. Pearson. *Human Anatomy and Physiology*, 7th ed. Chapter 27 pp1065-1090.

The menstrual cycle

Marieb, EN and Hoehn, K 2007. Pearson. *Human Anatomy and Physiology*, 7th ed. Chapter 27 pp1091-1100.

Pregnancy, childbirth and lactation

Marieb, EN and Hoehn, K 2007. Pearson. *Human Anatomy and Physiology*, 7th ed. Chapter 28 pp1101-1105; 1133-1139.

Family planning

Marieb, EN and Hoehn, K 2007. Pearson. *Human Anatomy and Physiology*, 7th ed. Chapter 28 pp1128-1129.

LA TROBE UNIVERSITY
SCHOOL OF HUMAN BIOSCIENCES

HBS1HRB Regulation of Human Body Function

TUTORIAL QUESTIONS

TUTORIAL 1

Do you have any questions?

1. Cell structure and size

- List the following in order of increasing size: mammalian cells; viruses; bacteria.
- State which of the above is eukaryotic, prokaryotic; state the distinguishing features of eukaryotic and prokaryotic cells.
- Explain why cells cannot exceed a maximum size.

2. The nature of bacteria and viruses;

how bacteria and viruses can change physiological function.

- Can bacteria grow, metabolize and reproduce independently of other cells?
- Can viruses grow, metabolize and reproduce independently of other cells?
- Explain what is meant by "gram positive bacteria" and "gram negative bacteria".
- List ways in which a bacterial infection can make us sick.
- Explain how viruses infect and replicate in cells.

3. Defences of the body against infection

"Barriers, inflammation, complement, interferons, 'natural killer' cells are non-specific defences against infection, while antibodies and cytotoxic-T cells are specific defences."

- Explain the distinction between specific and non-specific defences against infection.

State briefly the roles of each of the defences listed in the box above.

4. Enzymes

- Explain the following in your own words: enzymes are biological catalysts - enzymes are not modified as a result of a reaction; enzymes catalyse specific reactions.
- Enzymes decrease the activation energy required to start a reaction.
- Enzyme function is dependent on the immediate environment.
- Explain what is meant by "catabolism".

TUTORIAL 2

Do you have any questions?

Note that Practical 2 will combine some tutorial activities about reproduction and genetics.

Remember to bring any questions you have about any of the lecture content so far.

1. Energy and the cell

Explain why the body needs food, how food is used as a source of cellular energy, and what cellular activities require energy. *Use the slides provided if you wish.*

2. Genetic information in a cell

Explain what the diagram "genetic information in a cell" means. What is a gene? A chromosome?

Distinguish between DNA and RNA.

3. Protein synthesis

Explain in your own words the items 1-6 shown in the diagram which begins with 'DNA double helix', and ends with 'peptide' (labelled Saladin 5.10).

4. Cellular differentiation

All cells in a person's body have the same genetic information in the nucleus, and yet the cells are different from each other, eg there are different tissue types. Explain (briefly!) how this happens.

5. Mutations

Explain what a mutation is, and why a mutation can be a problem.

TUTORIAL 3

Do you have any questions?

Question 1

Name the main landmarks of brain anatomy

- lateral view
- sagittal section
- horizontal section

Name the main landmarks of spinal cord anatomy

Question 2

Describe the structure and functions of

- the meninges
- cerebrospinal fluid
- the blood brain barrier

Question 3

State the functions of the main cell types found in the brain.

LA TROBE UNIVERSITY
DEPARTMENT OF HUMAN PHYSIOLOGY & ANATOMY

HBS1HRB Regulation of Human Body Function

PRACTICAL CLASS NOTES

INTRODUCTION TO PRACTICAL CLASSES

Welcome to practical classes for *HBS1HRB Regulation of Human Body Function*.

The practical classes for this unit are all designed to reinforce material covered in the lectures and to introduce new material in a way that will not only be enjoyable but also an important learning tool.

Practical classes include educational, ethical and occupational health and safety considerations.

The aim of this INTRODUCTION TO PRACTICAL CLASSES is to inform you of these.

Practical classes which require student participation as subjects have obtained ethics approval. The Faculty Human Ethics Committee (FHEC) is the authority approving teaching practical classes involving human participation. Any queries or complaints not able to be sorted out by the staff member in charge should be addressed to The Secretary, Faculty Human Ethics Committee, Faculty of Health Sciences, or telephone 9479 3583 or email n.humphries@latrobe.edu.au.

Any risk inherent in a practical class has been minimised by appropriate means, including having at least one appropriately qualified and experienced staff member in charge of the practical.

There are some rules regarding practical classes:

Eating and drinking are prohibited in the laboratories, unless this is a part of the practical class procedure. Please do not bring food or drink into the laboratories.

Closed shoes must be worn whilst in the laboratories. This means that bare feet, sandals and thongs are not permitted. Students may wear a laboratory coat to practical classes, however, the wearing of a laboratory coat is not compulsory. Bags are to be placed in cupboards at the front of the class. Information is also provided in this introduction regarding *Infection control procedures*.

Each practical class commences with a brief talk designed to instruct on correct use of equipment, and to outline any Occupational Health and Safety issues relating to the practical. Please note that if you arrive more than 15 minutes after the class has commenced, you will not be allowed to stay.

Staff and students alike have a duty of care to make practical classes a safe and enjoyable experience, and to help to create an environment which facilitates learning and teaching. At the beginning of semester 2, students will be asked to read the practical notes for *HBS1HRB Regulation of Human Body Function*, and then to sign a document stating that they have read these notes and, for each of the three classes understand:

- the aims
- the practical procedures
- safety precautions (described in this INTRODUCTION TO PRACTICAL CLASSES, and
- that circumstances can affect some students which could make it advisable for them not to volunteer to be a subject for the procedure. *Note that the practical classes in HBS1HRB have minimal requirements for volunteers.*

Should any student require clarification regarding the aims, procedures, safety precautions and advice regarding participation as a subject, there will be an opportunity to obtain this in class discussion. Students are normally required to participate in the practical class program unless they have ethical objection to the class. Note however, that a student may choose, without prejudice, to not act as a subject for a particular class.

In order to make the most effective use of any practical, experimental, demonstration or computer assisted learning, the following should be kept in mind:

- Always read the practical notes prior to attending the practical.
- Attend the class punctually in order to hear the pre-lab talk where the class aims and the procedure will be explained, including any use of equipment and any particular safety precautions.
- Ask questions if you don't understand what you are doing.
- Get involved in the classes and enjoy them.

What skills will I obtain from these practicals and how will they assist in my finding a job?

This is a question often asked by students. The La Trobe University Careers Advisory Service recently asked prospective employers what skills they expected from a Science Graduate. The following list indicated skills these employers expected a Science graduate to have upon completion of their degree.

- Research
- Analysis of information
- Organisation and development of ideas
- Presentation of ideas
- Interpersonal skills
- Working with others in teams
- The use of mathematical ideas
- Problem solving
- The use of technology

The practical class program for HBS1HRB provides a beginning for the development of these skills.

Elizabeth Brown and Chris Handley
Coordinators, HBS1HRB

Standard precautions for practical classes

Certain infections such as the human immunodeficiency virus (HIV) and the hepatitis B and C viruses can be transmitted via infected blood or other body fluids. The following infection control procedures are adapted from “*Sure Protection Against Infection*” (March 1998), which is available from the Victorian government Department of human services. These procedures reduce the risk of transmission of such an infection. Note these procedures have application in everyday life. The Human Services booklet also includes information regarding various topics such as food preparation, general cleaning and first aid.

Infection control procedures

Assume that all samples/everyone are/is potentially infectious and treat all samples/everyone in the same way by practising infection control procedures.

(Note that protection of the client is implicit in these precautions).

Procedures

Thorough hand washing:

- after client contact
- after contact with used equipment
- as soon as possible should exposure to blood or other body fluids occur
- before preparing food
- before eating
- after removing gloves.

Thorough hand washing means:

- use soap and running water (a 15-20 second wash with soap and water)
- rub hands vigorously
- wash backs of hands, wrists, between fingers, under fingernails
- rinse well
- dry hands well, with a single-use paper towel where possible.

Gloves should be worn when:

- handling blood or body fluids
- handling equipment contaminated with blood or body fluids
- touching mucous membrane
- touching non-intact skin of any person
- performing venipuncture
- performing any invasive procedure.

Gloves are not necessary for contact with intact skin.

Any person at risk of splashes of blood or body fluids should:

- wear goggles or glasses
- wear protective clothing

Procedures for cleaning spills of blood or body fluids:

- wear gloves
- prevent splashing onto mucous membranes such as the eyes and mouth
- use bleach, in accordance with the manufacturers instructions
- soak up the substance with absorbent paper
- cover area with bleach for 10 minutes

- wipe and dry the area
- dispose of gloves and paper towelling in a plastic bag and seal the bag
- dispose of in accordance with institutional guidelines
- wash hands thoroughly.

Gloves, bleach solution and toweling will all be available.

Inability to attend a practical class

Students must normally attend practical classes with the group to which they have been assigned. If you are unable to attend a practical class because of illness, or for some other valid reason, but you can attend another scheduled session of the class, please contact Elizabeth Brown, 9479 5869 or e.h.brown@latrobe.edu.au for approval. Please supply a doctor's certificate or other appropriate documentation which explains your absence. Please understand that overcrowded practical classes become an Occupational Health & Safety issue.

As we noted previously (refer to the section UNIT ASSESSMENT), assessment in practical classes contributes to the final result in HBS1HRB. These tests are taken during attendance at the class. The practical mark usually contributes generously to a student's overall marks in the unit.

If you miss out on a practical class entirely, but have a valid reason for doing so, please fill out a copy of the form entitled "Absence from a practical class" and post or give this to Elizabeth Brown, along with any relevant documentation. Your practical mark will then be the average of the tests you were able to complete. In the absence of a completed form and documentation, you will be given a mark of zero for any class that you did not attend and therefore any test that you did not complete.

A copy of this form is provided at the end of this student manual.

Practical Session 1

Microscopic examination of cells

This practical class aims to introduce students to the care and use of the light microscope. It will be used to study a basic animal cell – an epithelial cell from the surface of the cheek.

In addition, various stages of mitosis will be examined, using prepared slides from an onion root tip (*Allium cepa*) or a whitefish blastodisc.

Care of the microscope

1. Check parts of microscope and report any damaged or missing parts **before** the practical starts.
2. Clean optical parts if necessary – use **only** lens tissue. Clean the other parts with Kleenex tissue.
3. When carrying a microscope **always** use both hands – one at the arm and the other under the base, and carry it vertically close to your body. Switch on to the lowest power when transporting.
4. You will be responsible for the care of your microscope during this practical session. Leave the microscope in the same condition as it was when given to you. Please replace its cover.
5. Absolute clarity of the image is essential in microscopy. It pays to clean your lenses each time before use.

A blurred image may be due to one or more of the following causes:

- a. Wet or dirty lenses, especially objectives.
- b. Dirty coverslip or slide (for example, due to finger prints on the coverslip).
- c. Water or fluid on coverslip.
- d. Wrong adjustment of light source or condenser.
- e. Section too thick or too oblique.

The lenses consist of one eyepiece x 10 and three objectives x 4, x 10, x 40.

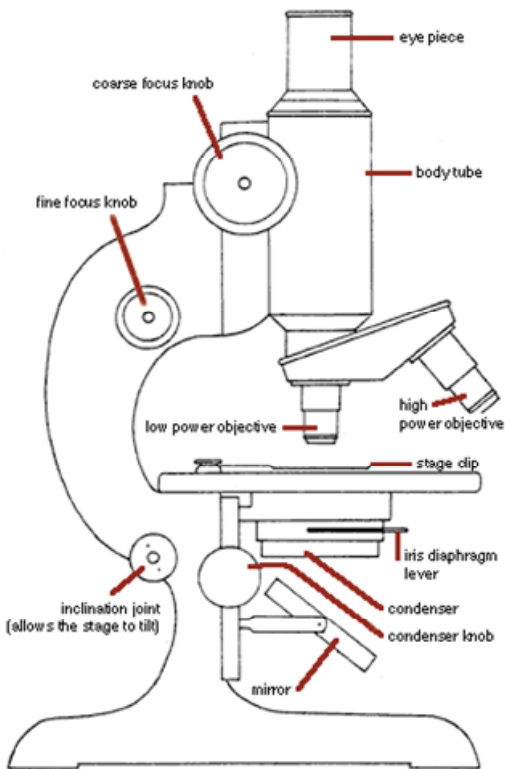
Total magnification is the product of the magnifications of eyepiece and objectives, i.e.

4 x 10 = 40 Very low power (VLP)

10 x 10 = 100 Low power (LP)

40 x 10 = 400 High power (HP)

If required to make a LP diagram use a x 100 and for HP drawing use x 400.



Parts of the microscope

Ocular or eyepiece magnifies the image formed by the objective lens

Body tube transmits the image from the objective lens to the ocular

Objective lenses primary lenses that magnify the specimen

Stage mount holds the microscope slide in position

Diaphragm controls the amount of light entering the condenser

Condenser focuses the light which goes through the specimen

Our microscopes use a built-in light source rather than a mirror

Our microscopes have the **coarse and fine focusing knobs** together

Knobs for moving the slide in the **X- and Y-directions** are not shown

Directions for use of the Microscope (Refer diagram)

1. Place the microscope several centimeters away from the edge of the bench.
2. Open iris diaphragm fully (usually left open).
3. Raise condenser to its upper limit or 1-2 mm from upper limit. (When observing non-stained specimens lower the position of condenser to achieve higher contrast.)
4. Zero illumination on base of microscope - "O".
5. Wall switch on.
6. Set illumination dial at 5 or 6.
7. Switch on to low power (x10 objective) first – always start with the low power.
8. Clean and place slide (coverslip up) on the stage and centre specimen beneath objective visually.
9. Use the coarse adjustment to focus on specimen: turn the adjusting knob so that the objective moves *away* from the slide, or (depending on the microscope) the slide moves away from the objective.
10. Use the fine focusing knob to focus the image.
11. Select field and switch on to high power (x400, if necessary). Use the fine focusing knob to focus the image.
12. Switch on to lowest power after use.
13. Zero illumination on microscope and wall switch off.

Abbreviations

TS – Transverse section

HP - High Power

LS – Longitudinal section

LP – Low Power

Experiment 1 – Setting up the microscope

A stained blood smear slide will be used to practice setting up and using the microscope.

Experiment 2 – Examination of living cells

1. Wash your mouth thoroughly with water.
2. Scrape the inside of your cheek (the buccal cavity) with the blunt end of a toothpick.
3. Dip the scrapings in a drop of saline on a slide.
4. Gently mount a coverslip using a mounted needle and examine cells under LP and HP (lower condenser to obtain higher contrast).

Vital staining – methylene blue

5. Irrigate your preparation (from step 3.) with methylene blue solution. Use filter paper to draw the dye through your cells.

6. Observe staining of cells under microscope and draw a diagram of a cell labelling the plasma membrane, cytoplasm and nucleus.

Methylene blue is a stain that moves into cells whether they are alive or dead. *Living* cells “decolourise” (metabolise) the stain and so *will appear colourless with time*. Dead cells will appear stained (blue).

Note the staining (or lack of) for the cells you obtained from your buccal cavity. Explain your observations.

Experiment 3 – Stages of mitosis

Examine a slide prepared from an onion root tip (*allum cepa*) or white fish blastodisc (demonstration) and try to identify the various stages of mitosis:

- | | | |
|--------------|---------------|-------------|
| a. Prophase | b. Metaphase | c. Anaphase |
| d. Telophase | e. Interphase | |

Summarise the main events of each of these phases.

Examine the models of a dividing cell with chromosomes and consult your text book and the web site listed below, to familiarise yourself with mitosis before the lecture later in the semester.

<http://www.cellsalive.com/mitosis.htm>

Wash your hands at the completion of the practical class.

Videos

DNA replication and mitosis 574.873282 D1117 Cell biol Prg 5
Mitosis (2nd ed) 574.87623 M6845

Practical Session 2

Brain dissection

Working in groups of 3-4, carry out the practical, describing to each other what you are finding and verbalising anatomical terminology.

Use the diagrams provided to assist in working through the practical.

PLEASE NOTE:

As you are dealing with preserved human tissue a few precautions should be observed.

Ensure that gloves are worn when handling tissue.

Wear a laboratory coat if you have one.

Wash hands at the completion of the practical.

THE WHOLE HUMAN BRAIN

Initial Observations

Note. The displayed brain is a human brain and as such is not to be dissected. However please feel free to probe and handle the specimen (using gloves) in aiding your observations.

1. Identify superficially the **meninges** (3 layers). The outermost dura mater will have been left behind on the inner surface of the skull; you will see parts of the arachnoid mater and the vessels to/from the brain which ramify in the sub-arachnoid space. The pia mater will lie on the surface of the brain.
2. Identify **surface features of the brain**. To initially identify the main parts of the brain – **cerebrum, cerebellum, midbrain, pons and medulla oblongata**, turn it over to expose the **VENTRAL SURFACE**.

The **cerebrum** is by far the largest part and includes the massive cerebral hemispheres which comprise approximately the anterior two-thirds of the brain. Their surfaces are marked by shallow grooves (sulci) and raised ridges (gyri). Note the **hypothalamus** and **mamillary bodies**.

The **cerebellum** lies below the posterior part of the cerebrum and is easily identified because its surface is cleft by a large number of closely set fissures separating long narrow folds called folia.

The **pons** is the white bulging bridge seen between the two halves of the cerebellum.

The **midbrain** is located by identifying the thick **cerebral peduncles** immediately anterior to the pons. They connect the hindbrain with the cerebral hemispheres.

The **medulla oblongata** extends from the lower border of the pons to the level of the spinal cord. It is marked by a **median fissure**, bordered by two bands, the **pyramids**.

Cranial nerves (12) emerge from the brain. Locate as many as possible using the accompanying diagrams.

The Forebrain

1. First locate the **central sulcus**, and **lateral fissure**. Use these landmarks to identify **FRONTAL, PARIETAL, OCCIPITAL** and **TEMPORAL LOBES**.
2. Then gently separate the two cerebral hemispheres along the long **longitudinal fissure** and find the **CORPUS CALLOSUM**. The corpus callosum is the broad horizontal band of fibres connecting the two hemispheres.
3. Observe the **displayed sections** and note:

The outer layer or cortex which is a **superficial** investment of **grey mater**, about an eighth of an inch thick. It consists of nerve cell bodies, neuroglial cells and blood vessels.

The central or **medullary** portion which consists of **white matter** – myelinated and unmyelinated nerve fibres, neuroglial cells and blood vessels. The fibres of the corpus callosum form the major commissural pathway of the white matter.

Practical Session 3

Reproduction & Genetics

PREGNANCY AND BIRTH

"Into the World" NURS AVV 612.63 INT:S (26 min)

This video addresses maternal changes in pregnancy, and some aspects of fetal physiology and development. Mechanisms of labour are illustrated and the stages of labour are described; a birth is shown.

Stages of labour: I - dilatation of the cervix; II - delivery of the baby; III - delivery of the placenta. The neonate and neonatal reflexes are shown.

Features of early child development are mentioned.

Note the following:

- physiological and anatomical changes which occur in the mother to accommodate the pregnancy.
- the ultrasound imaging of the fetus. Which features are visible in these ultrasound images? Suggest reasons why ultrasound is a useful diagnostic tool in pregnancy.
- changes in structure and function that must occur at birth for the baby.
- changes in maternal structure and function that must occur following birth of her baby.
- features of blood flow will be discussed. Note in particular that the fetal and maternal circulations are separate.

Human sperm

A video showing sperm from a number of semen samples which were collected for clinical investigation, will be observed.

DEMONSTRATIONS

Human placentae frozen after delivery, then thawed, will be demonstrated.

Note the:

- size, shape and quality of the tissues of these organs;
- maternal and fetal surfaces;
- umbilical cord and vessels;
- associated membranes.

Note that this is human material that must not be handled unless appropriate protective clothing is worn. Please refer to the Universal Precautions found in the INTRODUCTION TO PRACTICAL CLASSES pages of the manual.

Fetuses

- Observe the size and proportions of the preserved human fetuses, and of the fetal skeletons. Note the stained bone tissue of the preserved fetus.
- Observe the X-ray which shows the pregnant abdomen. Discuss the use of X-ray imaging as a diagnostic tool in pregnancy.

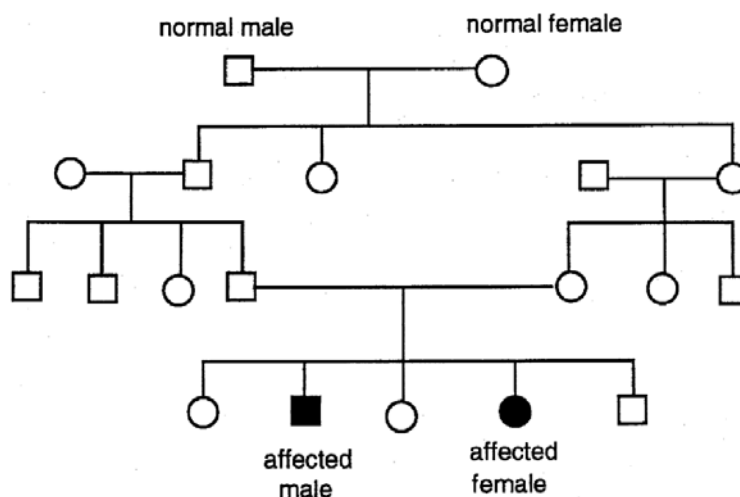
Models

- Observe the models which represent features of human fertilisation and development, arranging these in the appropriate sequence.
- Manipulate the models of the fetal skull and the female pelvis (with reference to the diagrams provided) in order to observe the most common ways in which the fetal head makes its descent through the pelvis, and is ultimately born.

GENETICS – PEDIGREE ANALYSIS

Patterns of simple Mendelian inheritance can be determined in humans, although there are constraints on the form of the genetic analysis. Humans have few progeny, they live in many different environments, generations are long and one cannot set up experimental crosses. These constraints can be circumvented by gathering family data, which are often presented in the form of pedigrees (family trees). From these pedigrees the most likely mode of inheritance can be deduced.

A worked example of this approach is provided below.



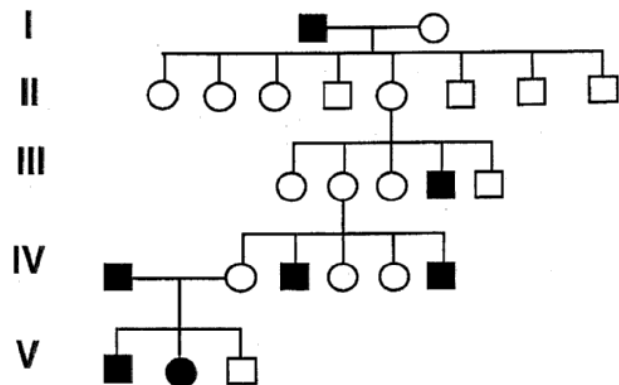
Very few individuals are affected, and those who are were the result of mating between normal people. A dominant mode of inheritance can therefore be excluded. Sex-linked recessive inheritance can be eliminated because the affected female has a normal father. This leaves us with autosomal recessive as the most probable mode of inheritance. Both parents would have to be heterozygous to produce affected offspring and as the parents are first cousins they are more likely to carry the same recessive gene.

Conclusion: The most likely mode of inheritance is autosomal recessive.

Examine the pedigrees on the following 2 pages and suggest the possible modes of inheritance involved.

Give full reasoning and show why other models have been rejected.

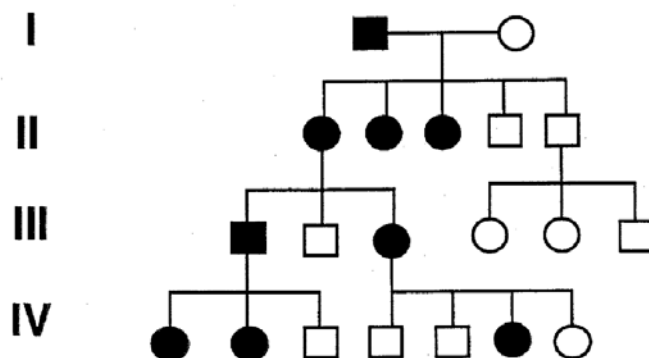
(1) **Night blindness**



What is the most likely mode of inheritance?

Reasons:

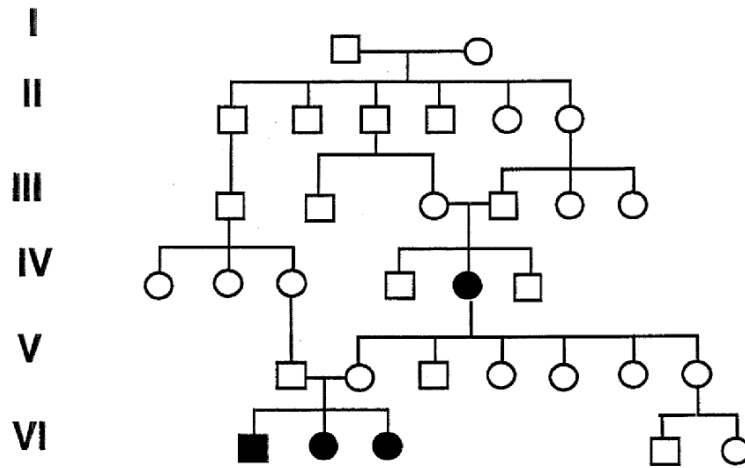
(2) **Vitamin D resistant rickets**



What is the most likely mode of inheritance?

Reasons:

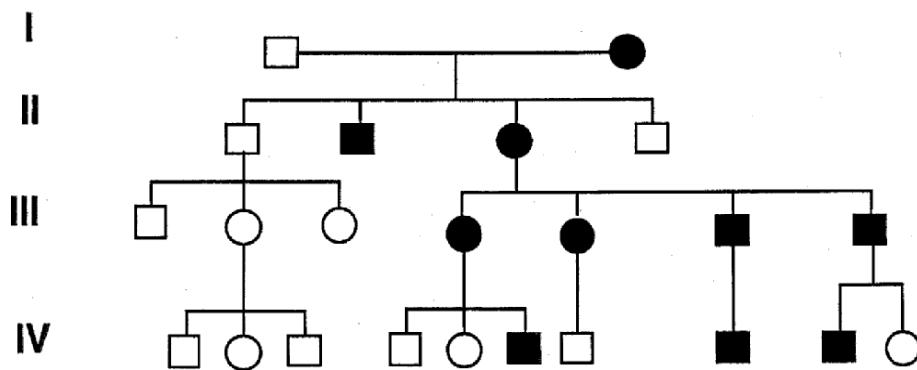
(3) Hartnup disease



What is the most likely mode of inheritance?

Reasons:

(4) Huntington Disease



What is the most likely mode of inheritance?

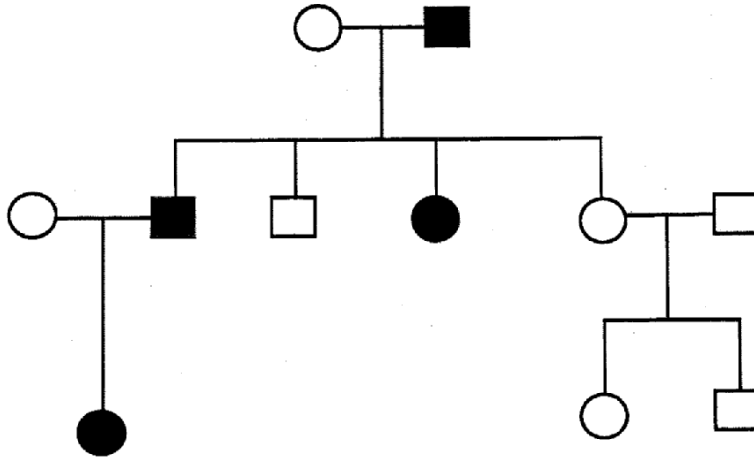
Reasons:

MODES OF INHERITANCE

The pattern of autosomal dominant inheritance is:

- Every person showing the trait has at least one parent who also shows the trait.
- If a large number of families are examined, there are about equal number of females and males with the trait.

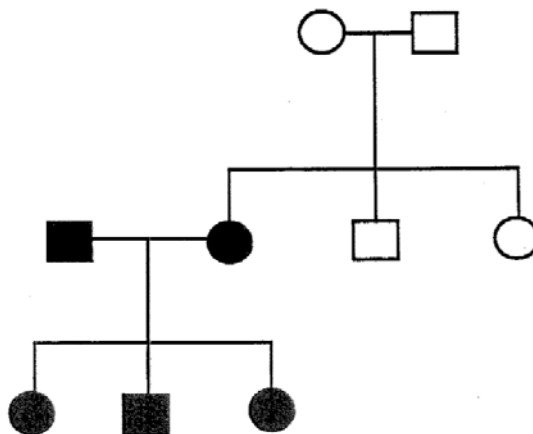
Pedigree showing inheritance of an autosomal dominant trait



The characteristics of an autosomal recessive trait are:

- If two parents show the trait all their children will show the trait.
- An affected person can have two unaffected parents.
- Males and females are equally likely to show the trait.

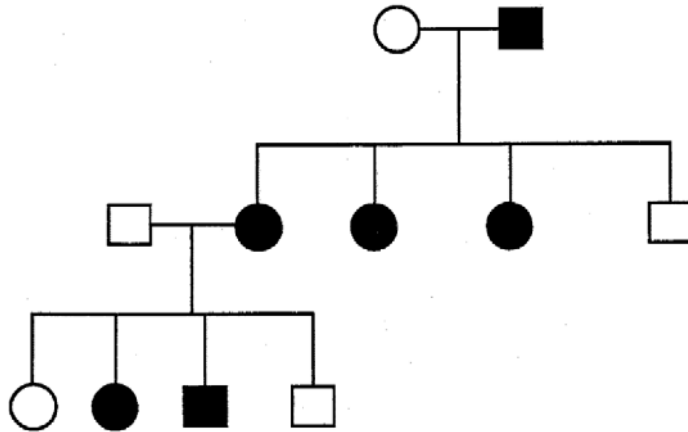
Pedigree showing inheritance of an autosomal recessive trait



The characteristics of an X-linked dominant trait include:

- An affected male must have an affected mother.
- All daughters of affected males will be affected.
- More females than males are likely to show the trait.

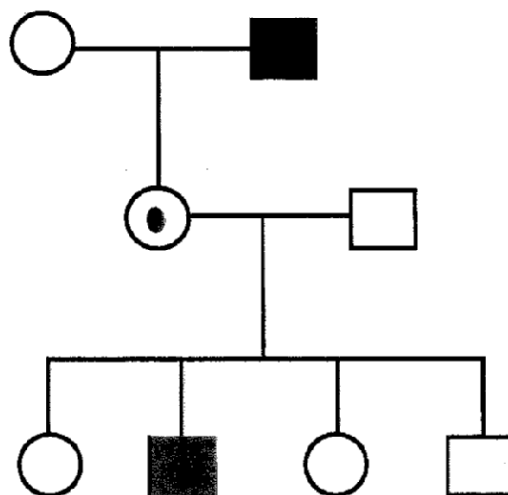
Pedigree showing inheritance of an X-linked dominant trait



The characteristics of an X-linked recessive trait include:

- More males than females will probably show the trait.
- A male with the trait cannot pass the allele responsible to his male offspring.
- ‘Carrier’ females do not show the trait, but may pass the allele concerned on to some of their sons who will show the trait.
- The trait may skip a generation. It may be passed from grandfather to grandson through a carrier daughter.

Pedigree showing inheritance of an X-linked recessive trait



Predict the characteristics and pedigree of a Y-linked trait

LA TROBE UNIVERSITY
SCHOOL OF HUMAN BIOSCIENCES
HBS1HRB Regulation of Human Body Function

Absence from a practical class

For the attention of Elizabeth Brown, unit coordinator.

Student number: Name:

Practical Group:

Class title:

Class day and date:

Reason for absence. *Note that if the matter is private, a brief indication will be sufficient.*

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Signed:

Date:

Documentation attached: doctor's certificate police report other (*please indicate*)

Noted:

Approved:

Please give this completed form to the unit coordinator, or hand in at School of Human Biosciences Reception, Level 1 Health Sciences, or post to Elizabeth Brown, School of Human Biosciences, La Trobe University 3086.