BIOL257

Neurophysiology

S1 External 2015

Dept of Biological Sciences

Contents

General Information

Unit convenor and teaching staff
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Credit points
3

Prerequisites
6cp(P) from BBE100 or BIOL108 or BIOL114 or BIOL115 or HLTH108 or HLTH109 or PSY104 or PSY105 or PSYC104 or PSYC105

Corequisites

Co-badged status

Unit description
This unit considers the function of nerves and hormones in the regulation of body functions. We begin with a discussion on how the selective permeability of the cell membrane gives rise to the electrical properties of cells, in particular nerve and muscle cells. The function and organisation of nerves into central and peripheral nervous systems, as well as specialised nerves and organs giving rise to the sensory system, is investigated in detail before we examine their role in homeostasis and muscle control. We then cover the neuroendocrine system, which is the link between the central nervous system and the endocrine system, before looking at the function of the main groups of hormones and their interrelationship with the immune system.
This unit is designed to serve science, medical science and chiropractic students and is also of interest to students studying psychology with an emphasis on physiology.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.

Describe the function of the autonomic nervous system.

Discuss perhipheral and central nervous system mechanisms in motor control including

muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
Comprehend scientific literature and express and discuss their conclusions.
Execute some of the techniques used in physiological measurement
Collect experimental data and draw conclusions from a simple analysis
Follow an experimental protocol
Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Assessment Tasks

Name	Weighting	Due
Weekly online quizzes	15%	Week 2-12
Mini test	10%	Week 4
Essay	10%	Week 7
Midsemester test	15%	Week 9
Final exam	50%	June

Weekly online quizzes

Due: **Week 2-12**
Weighting: **15%**

Weekly quizzes on the topic covered in that weeks' practical (ie week 3 practical will be on action potentials and membrane potentials, so the week 3 online quiz will consist of questions about this topic).

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control of movement and posture.
- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Mini test

Due: **Week 4**
Weighting: **10%**

This will be given during your normal practical time in week 4 for internal students. The questions will be on the practical material covered in the first 3 weeks of the unit and the first 6 lectures. External students will do a version of the test during their first external practical session on the 8th of April.

On successful completion you will be able to:

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.
- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Essay

Due: **Week 7**
Weighting: **10%**

The essay will be of 1,000 words on a topic of your choice from the list below:

1. The baroreceptor circuit and baroreceptor resetting during exercise.
2. Firing properties and neurochemical characteristics of brainstem neurons that regulate breathing.
3. Multiple sclerosis: pathophysiology and mechanisms of action of current and future treatment methods.
4. Pathophysiology of diabetic neuropathy.
5. Neurotoxin types and their mechanisms of action.

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- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
- Comprehend scientific literature and express and discuss their conclusions.
- Execute some of the techniques used in physiological measurement
- Collect experimental data and draw conclusions from a simple analysis
- Follow an experimental protocol
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Midsemester test

Due: **Week 9**
Weighting: **15%**

These will be given in your normal practical session, in ***week 9*** for internal students (7th & 8th May) and during ***the second on campus sessions for external students*** 24th May. Questions will be on lecture topics and laboratory material covered in weeks 1-8. The one-hour test will consist of multiple choice questions and short answers. Lecture material will be examined and you will need to have a level of understanding, in which you can describe cellular processes governing neuronal function, somatosensation and muscle control and contraction, describe the functional organisation of the nervous system and show how you can apply your knowledge of physiology to novel questions**.**

On successful completion you will be able to:

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of 'excitable cells'.
- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.

- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Final exam

Due: **June**
Weighting: **50%**

The exam will comprise a 3-hour paper with multiple choice and short answer questions. All lecture and practical material is examinable.

On successful completion you will be able to:

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of 'excitable cells'.
- Describe the function of the autonomic nervous system.
- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
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- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Delivery and Resources

DELIVERY AND RESOURCES

Delivery mode

This unit will be delivered through:

1. One 2 hours lecture per week, weeks 1 - 13
2. One 3 hours laboratory/tutorial class per week, weeks 2 – 6 and 7 – 12.

Students must register for a practical/tutorial slot on e-student

Class times and locations

Lectures: Wednesday 12:00 – 14:00 in C5C T1

Practical/tutorial: Thursday 14:00 – 17:00 *or* Friday 10:00 – 13:00 or 14:00 – 17:00 in the F7B laboratories, rooms 102, 105 and 110.

There are three practical classes running simultaneously during each time slot. Students must enroll into one of the practical/tutorial session of their choice.

External student sessions:

Session 1: Wednesday and Thursday 16 – 17 April (during mid-semester break) and;

Session 2: Saturday and Sunday 23 – 24 May.

Both sessions will be held in F7B rooms 105 and 110 from 9:00 – 16:00.

Practical classes

Attendance to practical/tutorial classes is compulsory and must be done in your enrolled practical/tutorial class time. Students must not exchange their class time. In special circumstances, students may request a specific change. These requests are to be submitted to the scientific officer, Ms Monika King.

Attendance requirements

If you miss your assigned practical in any week, you may request attendance at an alternative session through a written request with appropriate documentation (e.g., medical certificate) to the unit convener. This allowance may be used on a maximum of two occasions.

Unit web site

All lecture material and other essential unit information will be posted on iLearn (http://ilearn.mq.edu.au).

iLearn should be checked regularly for any updates.

Student support services

Macquarie University provides a range of academic and other student support services. Details of these services can be accessed at http://www.student.mq.edu.au

Required and recommended resources:

Required text for this unit:

- Stanfield CL. *Principles of Human Physiology* (5th ed). San Francisco: Benjamin Cummings-Pearson; 2012
- BIOL257 Laboratory Manual – available on iLearn website

Other recommended resources:

- Guyton AC and Hall JE. *Textbook of Medical Physiology (11th ed)*. Elsevier Saunders; 2006

Unit Schedule

INTERNAL CLASS SCHEDULE

Wk	Date	Lecture (2 × 1hr/week)	Lab session (1 × 3hr/week)
1	25 Feb	Introduction to physiology and cell membrane characteristics Membrane transport	**No practical**
2	4 Mar	Resting membrane potential and graded potentials Action potentials	Lab induction Resting membrane potential tutorial
3	11 Mar	Neuronal impulses and transmission The synapse: neurotransmitters and receptors	Action potentials and nerve conduction tutorial
4	18 Mar	Gross structure and spinal cord The brain and brainstem	PhysioEx Exercise 3: Neurophysiology of Nerve Impulses **Lab-based mini test**
5	25 Mar	Sensory receptors and pathways part I & II	Lamb brain dissection
6	1 Apr	Spinal and cortical control of muscles Muscle structure and physiology I	Somatosensation practical
Mid-semester break 6-19 April First on campus session for EXTERNAL STUDENTS 8 – 9 April			
7	22 Apr	Muscle structure and physiology II Reflex responses	Muscle physiology tutorial PhysioEx Chapter 12: Skeletal Muscle Physiology
8	29 Apr	The role of the cerebellum and basal ganglia in movement	Motor control case studies Reflexes practical

9	6 May	Vision Hearing and balance	**Mid-semester test**
10	13 May	Taste and smell The autonomic nervous system part I	Special senses practical
11	20 May	The autonomic nervous system part II Neuroendocrinology I	Autonomic nervous system tutorial and case study
12	27 May	Neuroendocrinology II Maintaining homeostasis: Role of the neuroendocrine system part I	Review/revision
13	3 June	Maintaining homeostasis: Role of the neuroendocrine system part II Review/revision	

EXTERNAL CLASS SCHEDULE

External **Session 1**	8 April, Wednesday	Lab induction Resting membrane potential tutorial Action potentials and nerve conduction tutorial PhysioEx Exercise 3: Neurophysiology of nerve impulses
	9 April, Thursday	**Lab-based mini test** Lamb brain dissection Somatosensation practical
External **Session 2**	23 May, Saturday	Muscle physiology tutorial PhysioEx Chapter 12: Skeletal muscle physiology Motor control case studies Reflexes practical
	24 May, Sunday	**Mid-semester test** Special senses practical and revision Autonomic nervous system tutorial and case studies

Learning and Teaching Activities

Topic 1: Cell membrane characteristics and membrane transport

1. Describe the structure and major functions of the plasma cell membrane 2. Explain the role of the chemical and electrical (electrochemical) driving forces in the passive transport of substances across the membrane, and distinguish between passive and active transport. 3. Identify the significant contribution of voltage and patch clamping to our understanding of the plasma cell membrane 4. Explain the components of Fick's Law in simple diffusion. 5. Describe facilitated diffusion through channels and by carriers and give specific examples. Compare the movement of molecules across the plasma membrane by carriers and through channels. 6. Differentiate between primary and secondary active transport and give specific examples 7. Identify the 3 general factors that influence the rate at which a substance can be passively transported across a membrane and identify the 2 general factors the influence the rate of active transport 8. Identify four factors affecting the permeability of membranes to molecules that cross by simple diffusion and explain how and why each affects permeability 9. Define endocytosis and exocytosis and explain the primary difference between these and other mechanisms of cellular transport

Topic 2: Resting membrane potential, the action potential, graded potentials and compound action potentials

Resting membrane potential (RMP) and graded action potentials 1. Define the concept 'equilibrium potential' (Nernst equation), values for K+, Na+ and Cl- ions, and its importance in resting membrane potential (RMP). 2. Describe the resting membrane potential of a cell in terms of the: a. Electrical and chemical forces acting on ions across the membrane, b. The ion primarily responsible for RMP c. The Goldman equation and value of the RMP in neurons and muscle cells d. Selective permeability of the membrane, and; e. Active transport mechanisms (Na-K pump) maintaining the RMP. 3. Define the terms polarisation, depolarisation, repolarisation and hyperpolarisation as they are used in the field of neurophysiology. 4. Define graded (electrotonic) potentials and their electrophysiological characteristics including direction of change in potential, magnitude of change and temporal and spatial summation. Explain how graded potentials in neurons trigger an action potential. 5. Describe spatial and temporal summation of postsynaptic potentials. 6. Define the terms 'excitable membrane' and 'excitable tissue; and explain how they differ from other non-excitable membranes and tissues. Action potentials 7. Define and action potential (AP) and explain the electrophysiological mechanisms underlying an AP. 8. Diagrammatically represent a recording of an AP against the appropriate time and voltage scales with reference to key ion permeability changes during an AP. 9. Define the term 'threshold' and its importance in the generation of APs. 10. Explain the 'all-or-none law of excitation' and how the intensity of a stimulus may be coded in the nervous system. 11. Define the 'absolute' and 'relative refractory periods', what causes them and their physiological significance. 12. Compare the action potential in skeletal, cardiac and smooth muscle 13. Describe how the compound action potential is measured, what it represents and how it varies with stimulus intensity.

Topic 3: Neuronal impulses and transmission: synapses,

neuromuscular junctions and more potentials.

The neuron and neuronal impulses 1. Describe the basic anatomy of a neuron and describe propagation of action potentials from axon hillock to axon terminal in normal function and when the axon is externally stimulated. 2. Understand the role of myelin and ‘Nodes of Ranvier’ in determining conduction velocity and compare myelinated to non-myelinated signal propagation along an axon. 3. Explain what is meant by ‘non-decremental spread’ of an AP and define the term ‘saltatory conduction’. 4. Explain the general function of the components of the neuron including the dendrites, soma, axon hillock, axon, telodendria, dendritic spines and synaptic terminals (terminal boutons). The synapse 5. Describe and draw a diagram of a chemical synapse with reference to: pre-synaptic nerve terminal, synaptic vesicles, synaptic cleft, position of presynaptic terminal on postysynaptic neuron, specialisation of postsynaptic membrane and neurotransmitter substance. 6. Define the terms ‘synaptic delay’ and ‘orthodromic transmission’. 7. Describe the process of synaptic transmission and list the sequence of events involved. 8. Explain the basic function and definition of a synapse. 9. Understand the difference between chemical and electrical synapses and know which is the more common in the mammalian nervous system 10. Understand the advantage of an electrical synapse over a chemical synapse in terms of speed of processing and synaptic delay. Graded potentials, neurotransmitters and receptors 11. Explain the different effects of excitatory and inhibitory neurotransmitters on the postsynaptic neuron. 12. Explain how an excitatory postsynaptic potential (EPSP) is generated at the postsynaptic neuron. 13. Define an inhibitory postsynaptic potential (IPSP) and list the sequence of events that lead to an IPSP. 14. Describe the criteria for defining a molecule as a neurotransmitter, and the classification into the major classes of neurotransmitters 15. Describe the 4 major functional classes of receptors (ligand-gated ion channels, tyrosine kinase coupled, steroid and G-protein coupled). 16. Give examples of common small-molecule neurotransmitters including the most common excitatory and most common inhibitory neurotransmitter in the nervous system.

Topic 4: Functional organisation of the nervous system

Gross structure 1. Diagram and describe the anatomical and functional classification of the nervous system with reference to the central and peripheral nervous systems and the major components of the central nervous system. 2. Describe the basic anatomy and anatomical classification of neurons. Compare the functions of each part of the neuron. 3. Describe what the ‘hierarchy of the central nervous system’ means. 4. Describe what constitutes ‘white matter’ and ‘grey matter’. 5. Define the term ‘nucleus’ as it is used in neurophysiology. 6. Define the Bell-Magendi Law of the nervous system. 7. Know and describe the arrangement of converging, diverging, reverberating and parallel circuits in the central nervous system and give examples of functions mediated by each 8. Describe the terms projection fibre, association fibre and commissural fibre. The spinal cord 9. Know the basic structure of the spinal cord in cross section including the terminology applied to, and the basic function ('sensory' or 'motor' & 'processing' or 'information propagation') of the major areas of grey and white matter. The brain 10. Identify the major functional areas of the cerebral cortex. 11. Understand the columnar organisation of the cerebral cortex. 12. Explain the difference between primary and association cortex and give examples of association cortex. 13. In simple terms, describe the basal ganglia in terms of their

structure (nuclei), location (subcortical) and function. 14. Identify the cerebellum, and in simple terms describe its role in movement. The brainstem 15. Define the boundaries of the brain stem and its three major components, the medulla, pons and midbrain. 16. Identify the location (medulla, pons or midbrain) and basic function of the following structures: a. Red nuclei b. Vestibular nuclei c. Superior and inferior colliculi 17. Describe the structure and various functions of the reticular formation. 18. Know the classification of sensory and motor neurons found in cranial nerves using the nomeclature of sensory systems (i.e. 1st, 2nd and 3rd order) or motor systems (upper motor neuron and lower motor neuron) as applicable. 19. Know the 12 cranial nerves and the basic sensory and/or motor functions of each nerve. The autonomic nervous system (ANS) 20. Explain the general role of the autonomic nervous system (ANS). 21. Explain why the ANS is divided into the sympathetic and parasympathetic components. 22. Anatomical (location of cell bodies of preganglionic neurons, length of pre- and post- ganglionic neurons, myelination etc) neurochemical (transmitters liberated) and functional differences and similarities (if any) between the sympathetic and parasympathetic nervous systems 23. Describe and draw the synaptic processes of signal transduction from the postganglionic neuron (sympathetic and parasympathetic) to the target organ (neurotransmitters utilized, how is neurotransmitter release triggered, receptors affected, excess neurotransmitter removal, effect on the end target organ) 24. Describe the role of the enteric nervous system

Topic 5: Sensory receptors and pathways

1. Differentiate general sensation (somatosensation) from the special senses 2. Define the term ‘receptor’. 3. Explain the terms ‘transduction of energy’ ‘sensory modality’ and ‘adequate stimulus’. 4. Classify sensory receptors according to: a. Adequate stimulus b. Location of the stimulus c. Innervation and location of receptors and d. Give specific examples for each receptor 5. Define a generator (receptor) potential and describe how it is generated. 6. Describe the terms dynamic (phasic) and tonic (static) in the context of the response profiles of neurons. 7. Define the term ‘adaptation’ in reference to sensory receptors and state its functional significance; what is slow and what is fast adaptation and what is the significance of each. 8. Explain how the intensity and duration of a stimulus are coded in action potentials within the nervous system. 9. Define the terms receptive field, sensory unit and recruitment of sensory units and discuss their significance. 10. Demonstrate an understating of what two-point discrimination is and how it is determined 11. Define the various sensory modalities that can be grouped under the heading ‘somatosensation’ (e.g. thermoception, mechanoception). 12. Define the terms ‘proprioception’ and ‘exteroception’. 13. Describe the structure and function of muscle spindles, golgi tendon organs and the various cutaneous receptors. 14. Understand the nomenclature of peripheral nerve fibres in relation to their myelination and conduction velocity (e.g. group Ia, Ib, II). 15. Describe the main somatosensory pathways of the central nervous system in terms of the sensory modalities they mediate and state how the concept of ‘somatotopic organisation’ is manifested in these pathways.

Topic 6: Muscle structure and function

Muscle structure 1. Describe the gross and ultrastructure of skeletal muscles including contractile and non-contractile components. 2. Differentiate between series and parallel elastic components of a muscle and describe the function of these non-contractile elements. The molecular basis of

muscle contraction 3. Describe the sliding filament theory of muscle contraction in terms of sarcomere shortening and whole muscle fibre contraction. 4. Describe the structure of thick myosin filaments and location of actin binding sites, ATP binding sites and the enzyme myosin ATP-ase on the myosin molecule. 5. Explain how Ca++ is able to initiate the contractile process by interacting with regulator proteins. 6. Describe how cycling of cross bridges between the globular heads of myosin and the actin filaments might give rise to the sliding of the filaments past each other to produce sarcomere shortening. Excitation contraction coupling and muscle relaxation 7. List the steps that occur between initiation of a muscle action potential at the end plate and the start of cross bridge cycling to produce sliding of the filaments. Use the terms sarcolemma, Ca++, troponin, tropomyosin, actin, myosin, ATP-ase, sarcoplasm. 8. List the events that lead to relaxation of a muscle and describe the role of ATP in the relaxation process. Muscle contraction, fibre types and muscle twitch 9. Describe the terms ‘isometric contraction’ and ‘isotonic contraction’ in terms of muscular effort against a moveable or immovable load. 10. On a record of an isometric twitch, label the: a. Axes, b. Latent period, c. Contraction time, d. Relaxation time, and; e. Twitch duration. 11. Differentiate muscle cell fibre types classified as Type I, IIa or IIb and/or slow twitch, fast twitch-high oxidative and fast twitch-low oxidative. Smooth muscle 12. Describe the microscopic appearance of smooth muscle. 13. Distinguish between multi-unit and single-unit smooth muscle. 14. Discuss the importance of gap junctions in smooth muscle in permitting single unit contraction of these muscles. 15. Describe the AP, pacemaker activity, pacemaker cells and explain the significance of this activity in auto-rhythmicity of smooth muscle. Cardiac muscle 16. Describe the microscopic appearance of cardiac muscle 17. Discuss the differences and similarities between cardiac and skeletal muscle. Why and how is the AP in cardiac muscle prolonged? 18. Describe how the strength of cardiac muscle contraction is regulated and how does this process differ from skeletal muscle.

Topic 7: Motor systems

The neuromuscular junction 1. Describe the location and functional anatomy of a neuromuscular junction. 2. List the sequence of events at the presynaptic terminal leading to the release of neurotransmitter substance. 3. Describe the synthesis, release, role and break down of acetylcholine (ACh) at the neuromuscular junction The motor unit 4. Define the term ‘motor unit’. 5. Describe the pattern of impulses arising from tonic and phasic inputs to the motor unit and describe the resulting muscle activity. 6. Define ‘motor unit recruitment’. 7. Compare the properties of small and large motor units and define the ‘size principle of motor unit recruitment’. 8. Describe the relationship between motor unit activity and graded muscle contraction. 9. Explain tonic and phasic muscle activity on the basis of recruitment. Spinal and cortical control of muscle 10. Define the term ‘segmental input’. 11. Define a lower motor neurone (LMN) and its role as the “final common pathway”. 12. Define an upper motor neurone (UMN) and explain its role as a driver of the LMN. 13. Define ‘muscle tone’ and describe how it is clinically assessed. 14. Describe the effects of LMN and UMN lesions on: a. Muscle tone, b. Stretch reflex activity, and; c. Voluntary muscle activity. 15. Define the level of the CNS at which the postural and movement UMNs originate and state the implications for the control of posture. 16. Provide alternative terms for M1 and M2 reflex responses. 17. Note the connection between M2 and the postural UMNs and explain the importance of this connection for postural control. 18. Identify 4 functional motor cortical areas. 19. Describe cells giving rise to long descending axons of the corticospinal tract and the functional areas in which they are found. 20. Describe the order in

which functional motor cortical areas will become active prior to a movement. 21. Identify two different sources of sensory input to the primary motor cortex, describe the type of information arising in each and its likely role in movement. 22. Describe the somatotopic organisation of the motor systems in both the spinal cord (ventral gray horn) and cerebral cortex. 23. Describe a simple reflex arc and describe how it is analogous to a negative feedback loop. 24. List the components of a polysynaptic reflex arc and compare to monosynaptic reflex arcs. 25. Diagram the stretch reflex, crossed-extensor-withdrawal reflex and the golgi tendon organ reflex. Characterise each reflex as monosynaptic or polysynaptic with reference to the definition of these terms. The role of the cerebellum and basal ganglia in movement 26. Identify four functional areas of the cerebellum and state how these areas relate somatotopically and functionally. 27. Explain the concept of the “error signal” in reference to the cerebellum and its function. 28. Suggest possible mechanisms that would permit the cerebellum to store motor programmes. 29. Identify the main sources of input to the basal ganglia. 30. Identify the input and output nuclei of the basal ganglia and simply state their role in motor function. 31. Define the direct and indirect pathways of the basal ganglia-thalamo-cortical loop. 32. Explain the function of the basal ganglia with reference to the direct and indirect pathways. Basic measurement of muscle and nerve function 33. Simply describe the technique known as electromyography and the terms ‘synchronous motor unit discharge’ and ‘asynchronous motor unit discharge’ 34. Describe how the compound action potential is measured, what it represents and how it varies with stimulus intensity.

Topic 8: Physiology of the special senses

Special senses pathways 1. Describe the sensory transduction mechanism for each of the special senses 2. Describe the basic anatomy and the neural pathway of each of the special senses, from sensory receptor to cerebral cortex. Compare and contrast these pathways for the various special senses 3. Compare and contrast the special sensory receptor with the somatic general receptor, and how action potentials are generated along the sensory afferent neuron in each case Auditory function 4. Describe the transference of sound energy from the pinna to the cochlea, and give the relevant anatomy and function of the structures involved that ensure and amplify transmission of the energy to the point of transduction 5. Indicate how the inner ear interprets intensity and pitch of sound 6. Give the safe sound intensity range and the normal frequency range heard by humans 7. Explain the coding for the quality of sound in the cochlea 8. Describe the various types of hearing loss, and how the Rinne’s and Weber’s tests can help to identify whether hearing loss has occurred and the type of hearing loss. Vestibular function 9. Describe the structure and function of the semicircular canals and vestibule, and how each codes for acceleration 10. Describe the possible mechanism behind motion sickness Vision 11. Describe how light is focused on the retina. In your answer, explain eye accommodation and how it is controlled neurally 12. Explain presbyopia, myopia and hyperopia 13. Describe how the iris regulates the amount of light that enters the eye 14. Explain the difference between rods and cones anatomically and functionally 15. Explain how colour is perceived 16. Discuss the process of adaptation to light and dark Gustation (taste) 17. Give the anatomy and function of the papilla and taste buds and how taste buds code for taste 18. Discuss how flavour is perceived Olfaction (smell) 19. Explain how olfaction is anatomically and functionally unique compared to the other special senses.

Topic 9 and 10: Neuroendocrinology and homeostasis

1. Define hormones and target cells 2. Explain the function of hormones in homeostasis 3. Differentiate between primary and secondary endocrine glands and list the hormones they secrete 4. Name the classes of hormones and describe their properties 5. Explain what is meant by the terms hormone receptors, signal transduction and second messenger pathways 6. Compare the signaling mechanisms used by steroid and non-steroid hormones 7. Be able to illustrate and describe how the hypothalamus regulates hormone release from the anterior and posterior pituitary glands 8. Describe the hypothalamic and pituitary hormones and the different roles of the posterior and anterior pituitary 9. Describe the neural, humoral and circadian rhythm control of hormone release 10. Contrast positive and negative feedback loops, and state why positive loops are not a key feature of homeostasis 11. Describe the hypothalamus-pituitary-adrenal axis (HPA axis) and the feedback control of this system 12. Compare the control of plasma glucose concentration following a meal and during fasting (or exercise).

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://stu

dents.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.
- Describe the function of the autonomic nervous system.
- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).

- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
- Comprehend scientific literature and express and discuss their conclusions.
- Execute some of the techniques used in physiological measurement
- Collect experimental data and draw conclusions from a simple analysis
- Follow an experimental protocol
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Assessment tasks

- Weekly online quizzes
- Essay
- Final exam

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.
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- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
- Comprehend scientific literature and express and discuss their conclusions.
- Execute some of the techniques used in physiological measurement
- Collect experimental data and draw conclusions from a simple analysis
- Follow an experimental protocol
- Follow the requirements of Occupation, Health and Safety legislation that apply in the

laboratory

Assessment task

- Essay

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.
- Describe the function of the autonomic nervous system.
- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
- Comprehend scientific literature and express and discuss their conclusions.
- Execute some of the techniques used in physiological measurement
- Collect experimental data and draw conclusions from a simple analysis
- Follow an experimental protocol
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Assessment tasks

- Weekly online quizzes
- Mini test
- Midsemester test
- Final exam

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.
- Describe the function of the autonomic nervous system.
- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
- Comprehend scientific literature and express and discuss their conclusions.
- Execute some of the techniques used in physiological measurement
- Collect experimental data and draw conclusions from a simple analysis
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Assessment tasks

- Mini test
- Midsemester test
- Final exam

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.
- Describe the function of the autonomic nervous system.
- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
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- Follow an experimental protocol
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Assessment tasks

- Mini test
- Essay
- Midsemester test
- Final exam

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.
- Describe the function of the autonomic nervous system.

- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
- Comprehend scientific literature and express and discuss their conclusions.
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- Collect experimental data and draw conclusions from a simple analysis
- Follow an experimental protocol

Assessment tasks

- Weekly online quizzes
- Mini test
- Midsemester test
- Final exam

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Discuss how properties of biological membranes are utilised in the nervous system and explain the concept of ‘excitable cells’.
- Describe the function of the autonomic nervous system.
- Discuss perhipheral and central nervous system mechanisms in motor control including muscle contraction, the stretch reflex, motor pathways as well as cortical and subcortical control of movement and posture.
- Discuss peripheral and central mechanisms of special senses (hearing and balance, vision and taste and smell).
- Describe how the nervous system and endocrine systems communicate in order to maintain homeostasis.
- Comprehend scientific literature and express and discuss their conclusions.

- Execute some of the techniques used in physiological measurement
- Collect experimental data and draw conclusions from a simple analysis
- Follow an experimental protocol
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Assessment tasks

- Weekly online quizzes
- Essay
- Midsemester test
- Final exam

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcomes

- Comprehend scientific literature and express and discuss their conclusions.
- Execute some of the techniques used in physiological measurement
- Collect experimental data and draw conclusions from a simple analysis
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Assessment task

- Essay

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

- Comprehend scientific literature and express and discuss their conclusions.

- Execute some of the techniques used in physiological measurement
- Collect experimental data and draw conclusions from a simple analysis
- Follow the requirements of Occupation, Health and Safety legislation that apply in the laboratory

Assessment task

- Essay