

A microscopic image of neurons, showing several large multipolar neurons with prominent cell bodies and branching dendrites. The neurons are labeled with letters A, B, C, D, and E. A large red 'DRAFT' watermark is overlaid diagonally across the center of the image.

**School of Psychology and Neuroscience**

**Session 2016-2017**

**Junior Honours Semester 1**

# **Neuroscience**

## **PN3313**

**Information booklet for students**

Please read carefully and keep for reference during the course

**Module Organiser: Dr Gareth Miles**  
**(gbm4@st-andrews.ac.uk)**

## Course aims and objectives

This module introduces some of the major principles of neuroscience, ranging from the molecular level through to whole animal behaviour. We cannot hope to cover the whole field in a single module, but the course aim is to give you a broad understanding of the following topics:

- how individual neurons work
- how neurons communicate with each other
- how the nervous system receives information from the environment
- how the nervous system can store this information
- how neural interactions can generate behaviour
- the methodologies used to explore both the cellular properties of individual neurons and the circuit properties of neuronal networks.

The course will provide you with a detailed knowledge of some specific areas of neuroscience, and equip you with the tools to extrapolate this knowledge into areas that are not covered by the course. At the end of this module you should be able to read and understand at least the main points of specialist review articles and original research papers in most areas of neuroscience. You should certainly be able to follow and critically assess the arguments in less specialist scientific articles and the popular press. Most importantly, you should have a general understanding of how the nervous system works in a broad range of animals, including yourselves.

### ***Transferable skills:***

Neuroscience is a topic that involves quite complicated mechanisms and processes. The neuroscience course is therefore an excellent vehicle for developing skills in logical thinking and deductive reasoning. You will be given the opportunity, working both independently and as part of a team, to hone your skills in the analysis, interpretation and presentation of data in a manner that informs the readers of the main features of the results and convinces them of the validity of your interpretation. You will utilise both primary and secondary literature to help construct coherent arguments. You will be given the opportunity to reflect upon and learn from feedback, based on your first lab report, which will benefit subsequent reports written for the course.

## Content delivery

The course consists of a series of lectures, computer simulation exercises and laboratory practical classes. Lectures are on the mornings of Monday, Tuesday and Wednesday throughout the semester. Practical classes are in the afternoons of weeks 4 and 7. Each student undertakes 2 laboratory exercises.

The exact time and location of the various sessions varies throughout the course, and so it is essential that you consult the timetable presented later in this handbook so that you know where you are meant to be, and when.

## Recommended texts

The course is not based on any single text in particular, but the following textbook is highly recommended:

***Principles of Neural Science*** by Eric Kandel, James Schwartz, Thomas Jessell.

Contains just about everything you might want to know about medical neuroscience and neurobiology. Copies of the 4<sup>th</sup> and new 5<sup>th</sup> edition are held in the Main Library, JF Allen Library and St Mary's College Library. This textbook can also be accessed as an e-book via the University Library website.

Note: Staff will also direct you to review papers and original articles which will be relevant to specific sections of the course.

## Assessment

The module is assessed by a combination of end-of-semester examination (60%) and two laboratory assessments (20% each).

### *Examination:*

There is a three-hour examination at the end of the semester. The exam is divided into three sections. You will be asked to answer one question from each section. The questions may require essay-type answers, or calculations, or data analysis, or any combination of these.

### *Laboratory work:*

There are two assessed laboratory exercises, in weeks 4 and 7 of the semester. Details of required write-ups will be given in the laboratories.

Specific School regulations relating to absence reporting, penalties and rules for late submission of work, extensions for coursework, academic misconduct policy and Academic Alert can be found in the School of Psychology and Neuroscience Honours Handbook.

For further information see the University Handbook: <http://www.st-andrews.ac.uk/studenthandbook>

## Topic Overview (chronology of the module)

1. The life and death of neurons: neurotrophic factors how they work, how neurons die.
2. Conduction within neurons: origin of the resting potential, cable conduction, generation of action potentials, conduction of action potentials.
3. Conduction between neurons (synaptic transmission): electrical and chemical synapses, physiology of pre-synaptic release mechanisms, post-synaptic mechanisms, voltage-dependent synapses, synaptic modulation.
4. Learning and memory: brain structures and cellular mechanisms.
5. Sensory neuroscience: transduction and central processing of sensory information with a focus on visual systems, sensorimotor integration.
6. Motor control: general principles and organisation of major motor control centres of the CNS, spinal circuits (central pattern generators) for generating rhythmic locomotor activity.
7. Basic neurology: what happens when things go wrong, upper and lower motor functions.

## Laboratory practical sessions

### *Practical 1: Exploring the mechanisms of neuronal cell death*

You will need to go to MMS to sign up for one of the following days of week 4:

Wed 5<sup>th</sup>, Thu 6<sup>th</sup> or Fri 7<sup>th</sup> October

Venue: Bute Neuroscience Laboratory

Laboratory Time: 2.00 – 5.00 pm

### *Practical 2: Recording action potentials from the giant axons of the earthworm*

You will need to go to MMS to sign up for one of the following days of week 7:

Wed 26<sup>th</sup> Oct, Thu 27<sup>th</sup> or Fri 28<sup>th</sup> October

Venue: Bute Neuroscience Laboratory

Laboratory Time: 2.00 – 5.00 pm

### *Lab write-up deadlines:*

The deadline for handing in laboratory work is TWO WEEKS (14 days) after the completion of the exercise or the availability of all data (whichever is the later). Lab write-ups must be submitted via MMS. Further details will be provided in the labs.

NOTE: you will be working in groups and are therefore likely to generate identical raw data. However, you MUST undertake data analysis and write up your results INDEPENDENTLY.

# Module Timetable 2015

## Lectures:

Bute Lecture Theatre D, 12:00 – 1:00pm

## Simulation sessions:

Weeks 5 & 7: Bute PC computer cluster (A21); Fri, 9:00 – 11:00am

## Practicals:

Week 4: Practical 1; Wed, Thu, Fri; 2:00 – 5:00pm; Bute Neuroscience Lab (C28)

Week 7: Practical 2; Wed, Thu, Fri; 2:00 – 5:00pm; Bute Neuroscience Lab (C28)

Date	Topic	Location	Time	Lecturer
<b>Week 1</b>				
Mon 12 <sup>th</sup> Sep	Course introduction	Bute LTD	12-1pm	Dr Miles
Tue 13 <sup>th</sup> Sep	Neurotrophic factors I	Bute LTD	12-1pm	Dr Doherty
Wed 14 <sup>th</sup> Sep	Neurotrophic factors II	Bute LTD	12-1pm	Dr Doherty
<b>Week 2</b>				
Mon 19 <sup>th</sup> Sep	Neuroprotection	Bute LTD	12-1pm	Dr Doherty
Tue 20 <sup>th</sup> Sep	Conduction within neurons	Bute LTD	12-1pm	Dr Heitler
Wed 21 <sup>st</sup> Sep	Conduction within neurons	Bute LTD	12-1pm	Dr Heitler
<b>Week 3</b>				
Mon 26 <sup>th</sup> Sep	Conduction within neurons	Bute LTD	12-1pm	Dr Heitler
Tue 27 <sup>th</sup> Sep	Conduction within neurons	Bute LTD	12-1pm	Dr Heitler
Wed 29 <sup>th</sup> Sep	Synaptic transmission	Bute LTD	12-1pm	Dr Li
<b>Week 4</b>				
Mon 3 <sup>rd</sup> Oct	Synaptic transmission	Bute LTD	12-1pm	Dr Li
Tue 4 <sup>th</sup> Oct	Synaptic transmission	Bute LTD	12-1pm	Dr Li
Wed 5 <sup>th</sup> Oct	Synaptic transmission - modulation	Bute LTD	12-1pm	Dr Li
<b>Practical 1: Mechanisms of neuronal death (Wed, Thu, Fri, 2-5pm; Bute Neuroscience Lab; Dr Doherty)</b>				
<b>Week 5</b>				
Mon 10 <sup>th</sup> Oct	<b>Practical 1: class discussion</b>	Bute LTD	12-1pm	Dr Doherty
Tue 11 <sup>th</sup> Oct	Learning and memory I	Bute LTD	12-1pm	Dr Li
Wed 12 <sup>th</sup> Oct	Learning and memory II	Bute LTD	12-1pm	Dr Li
SIMULATION SESSION 1 (Fri, 9-11am; Dr Heitler and Dr Li)				
<b>Week 6</b>				
<b>Independent learning week</b>				
<b>Week 7</b>				
Mon 24 <sup>th</sup> Oct	Motor systems	Bute LTD	12-1pm	Dr Miles
Tue 25 <sup>th</sup> Oct	Motor systems	Bute LTD	12-1pm	Dr Miles
Wed 26 <sup>th</sup> Oct	CPGs - pacemakers	Bute LTD	12-1pm	Dr Miles
SIMULATION SESSION 2 (Fri, 9-11am; Dr Heitler and Dr Li)				

<b>Practical 2: Recording action potentials (Wed, Thu, Fri, 2-5pm; Bute Neuroscience lab; Dr Heitler)</b>				
<b>Week 8</b>				
Mon 31 <sup>st</sup> Oct	SIMULATION 1 review	Bute LTD	12-1pm	Dr Heitler
Tue 1 <sup>st</sup> Nov	CPGs - swimming	Bute LTD	12-1pm	Dr Li
Wed 2 <sup>nd</sup> Nov	CPGs - walking	Bute LTD	12-1pm	Dr Miles
<b>Week 9</b>				
Mon 7 <sup>th</sup> Nov	Sensory systems	Bute LTD	12-1pm	Dr Pulver
Tue 8 <sup>th</sup> Nov	Vision I	Bute LTD	12-1pm	Dr Pulver
Wed 9 <sup>th</sup> Nov	Vision II	Bute LTD	12-1pm	Dr Pulver
<b>Week 10</b>				
Mon 14 <sup>th</sup> Nov	Basic Neurology I	Bute LTD	12-1pm	Prof Gunn-Moore
Tue 15 <sup>th</sup> Nov	x	x	x	x
Wed 16 <sup>th</sup> Nov	Sensorimotor integration I	Bute LTD	12-1pm	Prof Sillar
<b>Week 11</b>				
Mon 21 <sup>st</sup> Nov	Sensorimotor integration II	Bute LTD	12-1pm	Dr Miles
Tue 22 <sup>nd</sup> Nov	Basic Neurology II	Bute LTD	12-1pm	Prof Gunn-Moore
Wed 23 <sup>rd</sup> Nov	Guest lecture	Bute LTD	12-1pm	Dr Ros Langston (Univ. Dundee)
<b>Revision week</b>				
Mon 28 <sup>th</sup> Nov	Revision/feedback	Bute LTD	12-1pm	
Tue 29 <sup>th</sup> Nov	Revision/feedback	Bute LTD	12-1pm	
Wed 30 <sup>th</sup> Nov	Revision/feedback	Bute LTD	12-1pm	

## Contact Details for Lecturers

**Dr Gareth Miles:** [gbm4@st-andrews.ac.uk](mailto:gbm4@st-andrews.ac.uk) (module organiser)

Dr Gayle Doherty: [ghm@st-and.ac.uk](mailto:ghm@st-and.ac.uk)

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