BS362-12 Integrative Neuroscience

22/23

Department
Life Sciences
Level
Undergraduate Level 3
Module leader
Nicholas Dale
Credit value
12
Module duration
10 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module will cover selected topics in contemporary neuroscience in a hierarchical manner. The content will be closely related to the research interests of the teaching staff. The overall aim of the module is to consider the important cellular components of the CNS and how these determine and contribute to the integrative function of the nervous system. The module will cover signalling in the CNS, genetic targeting and manipulation of brain cells, the roles of glial cells, cortical function and development, motor control, sleep, sexual behaviour and consciousness.

Module web page

Module aims

At the end of this module, a student should understand the mechanisms that control the electrical properties of neurons, why these are important, and the methods and mechanisms of communication used within the nervous system. The student should understand the operation of neural circuits in the context of motor control, how the components of neurons can influence the operation of these circuits, and how these circuits can generate both autonomic and higher-order behaviour. Students should understand how breakdown in the neural components can lead to disorders and the implications that such a breakdown has on human health. Students should understand how higher brain functions including consciousness can be studied

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Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

1 Communication in the Nervous System (8 lectures - Dr. M. J. Wall/Professor N. E. Dale/ Professor G. Koentges)

Ion channels and how to study them, application of molecular methods, examples of function. Synaptic transmission using glutamate and GABA as models. Purinergic signalling – signalling roles of ATP and adenosine. Glial cells, their types and roles in the brain; glia – neuron communication. Signalling via gap junctions and hemichannels. Methods to visualize neuronal circuits, traditional and genetic. Genetic manipulation and targeting of specific cells in the brain. Optogenetic approaches to analyze and experimentally modify specific neuronal circuits.

Motor Control (2 lectures - Dr. M. J. Wall)

Role of cerebellum in motor control; motor learning; disorders of movement based on cerebellum. Disorders of movement based in higher centres: Parkinson’s, Huntington’s and the polyglutamine diseases.
Development of Forebrain and Cortex (2 lectures - Professor G. Koentges)

Genetic control of forebrain development, specification of neuronal areas, development of the cortical regions and layers, the hippocampus, principles of circuit formation – we will explore the mechanisms by which the forebrain builds various maps of the outside world.

Cortical Function and Signalling (2 lectures - Dr. M. J. Wall)

These 2 lectures cover neocortical morphology and cortical wiring and discusses the emergent neural activity that can be produced. It also covers pyramidal cell properties and the different classes of GABAergic interneurons in the neocortex.

Neurobiology of Sexual Behaviour (3 lectures - Dr. K. G. Moffat/Professor G. Koentges)

The first lecture (KGM) will begin by looking at the well characterised sexual behaviours found in invertebrates, concentrating on Drosophila, where both genetic elements and neural circuitry of male sexual behaviour and female receptivity have been well characterised. In particular we will look at how this circuitry can be manipulated to alter these behaviours through mutations, genetic mosaics and optogenetics.

In the second lecture (GK) we will trace the circuitry of pheromone sensing in mice from the olfactory neurons to the olfactory bulb and further to the amygdala and we will look at the

behaviours elicited by pheromones and the changes of these behaviours that result from genetic ablations.

Finally (KGM), we will look at the relationship of sexual behaviour and parasites, which, in a variety of animals, are reported to alter the behaviour of hosts. While this has interesting evolutionary implications and is the subject matter of the famous microevolutionary “Red Queen” hypothesis, here we will look in detail at toxoplasmosis: the way in which mate choices are made, the biochemical alterations to pheromones and the relationship between altered fear behaviour and neuroanatomy of the amygdala.

Neurobiology of Sleep (2 lectures - Professor N. E. Dale)

The functions of sleep, and the neural mechanisms that control sleep and wakefulness.

Higher Brain Function (1 lecture - Professor N. E. Dale)

What is consciousness? Split brain studies – what they reveal about the operation of the brain and neurobiological basis of consciousness.

Learning outcomes

By the end of the module, students should be able to:

- LO1 Demonstrate understanding of communication within the nervous system
- LO2 Demonstrate understanding of motor control and disorders that are associated with a breakdown in control mechanisms
- LO3 Demonstrate understanding of brain development and the R&D techniques needed to study development
- LO4 Demonstrate understanding of cortical function and structure
- LO5 Demonstrate understanding of the neurobiology of sexual behaviour
- LO6 Demonstrate understanding of the neurobiology of sleep
- LO6 Demonstrate understanding of the neurobiology of sleep

Indicative reading list

Bear, Connors and Paradiso, Neuroscience – Exploring the Brain, 3rd edn. (Lippincott Williams and Wilkin, 2007).

Kandel, Schwartz, Jessell and Hudspeth, Principles of Neural Science, 5th edn. (McGraw-Hill, 2012).

More specific background literature will be supplied in conjunction with the lectures.

Subject specific skills

a. Demonstrate clear understanding of the scientific topic

b. Contain evidence of extended reading and lateral integration of material not covered in the lectures

c. Demonstrate independent thought and deep understanding

d. Specifically answer the set question using information from multiple lectures and sources

e. Be structured and formatted in a way that demonstrates understanding and logical flow

f. Use multiple sources to construct complex scientific arguments and integrating these to build and develop the student's own scientific conclusions.

Transferable skills

1. Critical appraisal of source material
2. Self directed learning
3. Adult learning

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (17%)
Private study	100 hours (83%)
Total	120 hours

Private study description

100 hrs of self-study and directed reading

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group B1

	Weighting	Study time
Written Examination	100%	

Feedback on assessment

Pastoral meetings with personal tutor

Past exam papers for BS362

Availability

Courses

This module is Core optional for:

- UBSA-C1B9 Undergraduate Biomedical Science
  - Year 3 of C1B9 Biomedical Science
  - Year 3 of C1B9 Biomedical Science
  - Year 3 of C1B9 Biomedical Science
- Year 3 of ULFA-C1A3 Undergraduate Biomedical Science (MBio)

This module is Optional for:

- Year 3 of UMDA-CF10 Undergraduate Integrated Natural Sciences (MSci)

This module is Option list A for:

- Year 3 of UBSA-C700 Undergraduate Biochemistry
- ULFA-C1A2 Undergraduate Biochemistry (MBio)
  - Year 3 of C1A2 Biochemistry
  - Year 3 of C700 Biochemistry
- UBSA-3 Undergraduate Biological Sciences
  - Year 3 of C100 Biological Sciences
  - Year 3 of C100 Biological Sciences
  - Year 3 of C105 Biological Sciences with Molecular Genetics
  - Year 3 of C107 Biological Sciences with Virology
- Year 3 of ULFA-C1A1 Undergraduate Biological Sciences (MBio)
- UBSA-C1B9 Undergraduate Biomedical Science
  - Year 3 of C1B9 Biomedical Science
  - Year 3 of C1B9 Biomedical Science
  - Year 3 of C1B9 Biomedical Science
- ULFA-C1A3 Undergraduate Biomedical Science (MBio)
  - Year 3 of C1A3 Biomedical Science
  - Year 3 of C1B9 Biomedical Science

This module is Option list B for:

- UBSA-3 Undergraduate Biological Sciences
  - Year 3 of C102 Biological Sciences with Cell Biology
  - Year 3 of C103 Biological Sciences with Environmental Resources
  - Year 3 of C104 Biological Sciences with Microbiology