LF268-15 Invertebrate Neuroscience

23/24

Department
Life Sciences
Level
Undergraduate Level 2
Module leader
Erik Griffin
Credit value
15
Module duration
5 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

Invertebrates have many and varied nervous systems that reflect their evolutionary routes and potential reemergence. Their equally varied behaviours, ranging from simple chemosensing and reflex responses, to higher cognitive functions in bees and octopus, is a constant source of amazement. In addition, as models of the vertebrate and mammalian nervous systems they have provided much insight, while biotechnological applications have emerged from insect sensory systems. This module will provide our BSc Neuroscience students with a broad appreciation of the remarkable nervous systems that invertebrates possess.

Module aims

This module will explore the nervous systems and behaviours of invertebrates ranging from sponges through ctenophores, planaria and cnidaria to nematodes, Drosophila and social insects (eg bees). It will address the evolutionary diversity of invertebrate nervous systems, the acquired and inherited behaviours displayed by invertebrates, and the sensory systems, epigenetic mechanisms and neuronal networks that underpin them.

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.

Lectures

1. Invertebrate NS evolution 1

2. Invertebrate NS evolution 2
   The study of the nervous system in certain invertebrates has offered valuable insights into the fundamental principles of nervous system function. Studying these organisms has allowed researchers to delve into various aspects of neurobiology, including neural circuitry, development, genetics, behaviour, evolution, and aging. We will explore how the relative simplicity of their nervous systems has facilitated detailed investigations across multiple biological levels, leading to a deeper understanding of how nervous systems work. These topics will be expanded on in the workshop “How many times did nervous systems evolve?”

3. Invertebrate sensory systems 1 Olfaction & gustation
   The molecular and cellular mechanisms of insect olfaction and taste will be explored. These will be compared to the mechanisms of vertebrate olfaction and taste originally covered in LF108. These topics will be expanded on in the workshop “Biotechnology from insect receptors”.

4. Invertebrate sensory systems 2 Vision
   The molecular and physical evolution of invertebrate vision will be delivered, looking at both anatomy and gene network conservation across Phyla. From sensing through a range of opsins to processing in the brain, we will examine the amazing array presented by these animals.

5. Learning and memory
   The genetic dissection of learning in Drosophila and the wider lessons for synaptic plasticity and memory storage will be considered; the initial observations of learning type behaviours and the genetic dissection of both learning and memory. We will explore techniques used to identify the anatomical locations and the modern methodologies for manipulation of these processes.

6. Higher cognitive functions
   The evidence that invertebrates such as cephalopod molluscs and social insects (concentrating on bees) are capable of apparently advanced cognition will be considered. A companion workshop will explore the evidence for bee cognition in depth.

7. Epigenetic modes of experience transmission 1

8. Epigenetic modes of experience transmission 2
   Environmental stimuli perceived by the parental nervous system can lead to the development of offspring with adaptations tailored to the parental environment. This concept challenges a long-standing dogma in biology that posits the soma's inability to influence the germline. We will explore emerging evidence from invertebrate research, which suggests that this phenomenon is more prevalent than previously believed. These topics will be expanded on in the workshop “Epigenetics and inherited behaviour”.

Workshops
1 How many times did nervous systems evolve?

2 Biotechnology from insect receptors
3 Bee cognition
4 Epigenetics and inherited behaviour

Learning outcomes

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

- LO1 Demonstrate understanding of the diversity of invertebrate nervous systems
- LO2 Demonstrate understanding of the evolutionary basis of this diversity
- LO3 Demonstrate understanding of invertebrate sensory systems, in particular olfaction, gustation and vision
- LO4 Demonstrate understanding of examples and mechanisms of learning and memory in invertebrates
- LO5 Demonstrate understanding of higher cognitive functions, such as counting, in invertebrates
- LO6 Demonstrate understanding of epigenetic mechanisms as they apply to the inheritance of learned behaviour
- LO7 Demonstrate understanding of how invertebrates are similar to and differ from higher vertebrates
- LO8 Demonstrate understanding of how knowledge gained from invertebrates has assisted understanding of the mammalian nervous system
- LO9 Demonstrate understanding of how resources obtained from the invertebrate nervous systems can assist in biotechnological applications.
- LO10 Demonstrate understanding of the value and benefits of invertebrate neuroscience research

Subject specific skills

Reading the scientific literature relevant to the topic
Gaining knowledge of the evolution and diversity of invertebrate nervous systems
Understanding the primary routes of sensory experience in invertebrates.
Understanding the mechanisms underlying the acquisition of learning, display of memory and presence of higher cognitive functions in invertebrates
Understanding the transmission of parental experience through the germline.
Understanding how invertebrate nervous systems can both be used to model those in vertebrates and mammals, and can be used for biotechnological purposes.

Transferable skills

Reading professional literature
Assimilating this information into cogent verbal and written presentations.
Discussing and sharing opinions and data with peers and staff .
Self-directed study
Writing of a report

Study

Study time

Type	Required
Lectures	8 sessions of 1 hour (5%)
Practical classes	4 sessions of 2 hours (5%)
Other activity	4 hours (3%)
Private study	50 hours (33%)
Assessment	80 hours (53%)
Total	150 hours

Private study description

Students will be provided with lecture notes and reading material for the workshops.

Other activity description

timetabled pre-workshop study time

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D

	Weighting	Study time	Eligible for self-certification
Summary of workshop activities	30%	6 hours	Yes (extension)
Students will be required to integrate information gained from workshops into a cogent report			
End of Year Assessment	70%	74 hours	No
Short answers and essay/mini essay/data/vignette type questions			

Assessment group R

	Weighting	Study time	Eligible for self-certification
End of Year Assessment	100%		No

Short answers and essay/mini essay/data/vignette type questions

Feedback on assessment

Lecturer & Tutor feedback

Past exam papers for LF268

Availability

Pre-requisites

To take this module, you must have passed:

- All of
  - LF108-12 Cell Biology of Neurons

Courses

This module is Optional for:

- Year 2 of ULFA-B140 Undergraduate Neuroscience (BSc)
- Year 2 of ULFA-B142 Undergraduate Neuroscience (MBio)
- Year 2 of ULFA-B143 Undergraduate Neuroscience (with Industrial Placement) (MBio)
- Year 2 of ULFA-B141 Undergraduate Neuroscience (with Placement Year) (BSc)