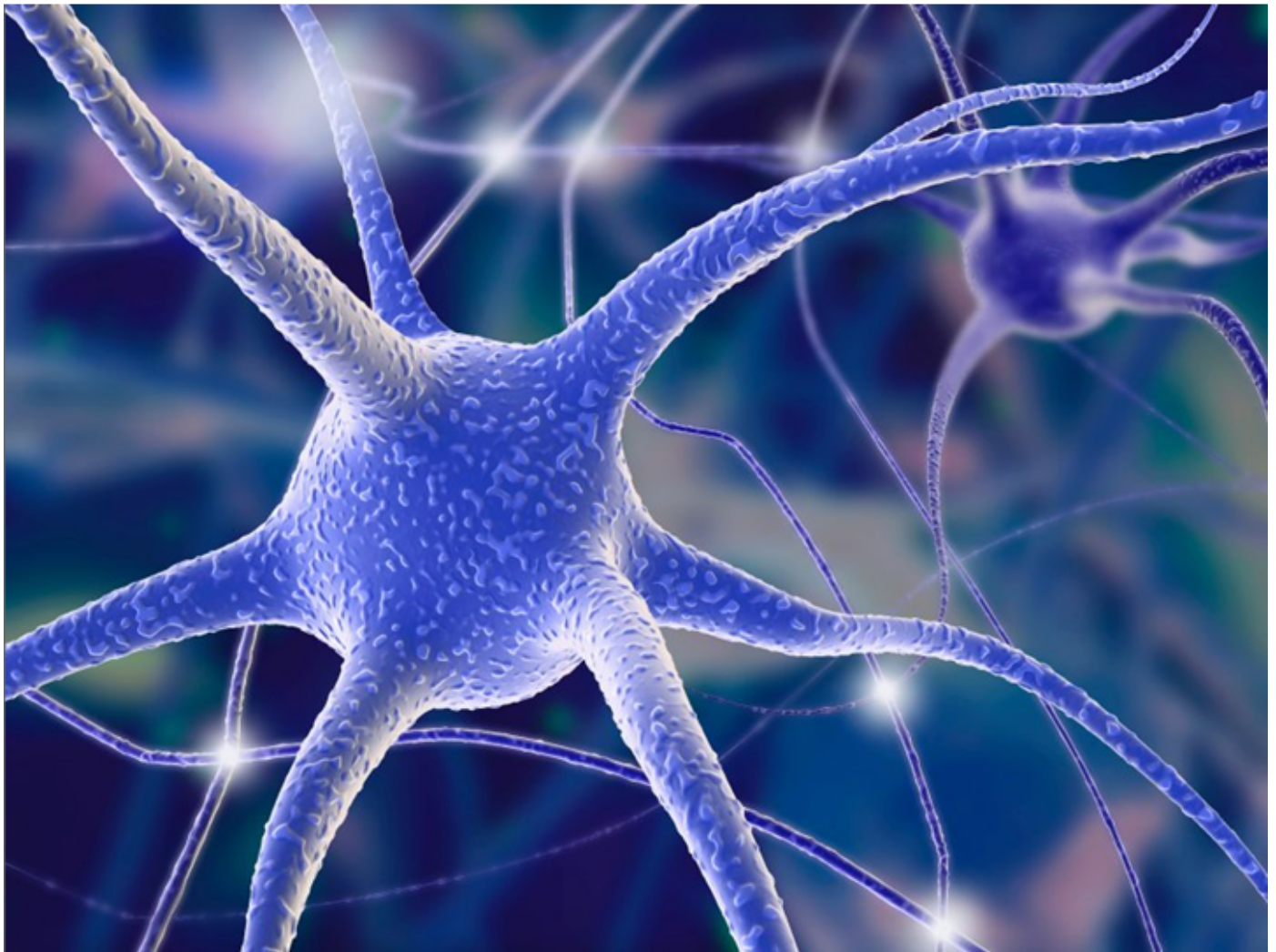


Neurosciences

KING'S
College
LONDON



booklet

6BBA3009 Principles of Neurobiological Research

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6BBA3009

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Principles of Neurobiological Research (6BBA3009) Course Booklet and Timetable 2010/2011

AIMS

The aim of this course is to give students a broad overview of the process of research, starting with the design of experiments, guidelines how to approach a scientific paper, an overview of key model systems and techniques used to study brain development, an update on statistical methods up to a discussion of topics of the wider context of neuroscientific research. This course is a preparation for the practical part of your BSc study (6BBA3012) done primarily in Semester B, where you will work on a rather confined aspect of neurobiological research.

Generally the course is organised into a first session where a particular theme is presented as a lecture by a scientist with specialist knowledge in that particular field, while in a second session the same topic will be re-assessed on a practical level including various demonstrations.

LEARNING OUTCOMES

By the end of the course students

- have been introduced to guidelines how to design experiments
- are able to read efficiently scientific papers
- gained an understanding of the key animal model systems and in vitro techniques used in neurobiological research and their applications
- have developed a solid basis for data handling and statistics in neurobiological research
- have been introduced to key molecular-biological techniques
- have got an overview of how to study synapse function
- have been introduced to principles of electrophysiology
- are familiar with techniques to visualise development of the nervous system
- have actively discussed topics which are at present controversial in the neuro-scientific community

ASSESSMENT

20% - homework on 'data handling and statistics'

20% - assessed presentation (GREAT DEBATE)

60% - two hour examination

PRIVATE STUDY TIME

You are encouraged to use your private study time effectively and re-capitulate topics so far discussed in the course. In particular, the statistics homework and the preparation for the GREAT DEBATE will require some attention. So it might be a good time to get organised EARLY with your colleagues for this event, get soon an outline of your presentation and meet with your tutor on that topic.

TIMETABLE OVERVIEW

Wedn Sept 29 th	Classroom 6 Hodgkin building 9am – 9.30am 9.30am – 11am 11am – 12am	Introduction to Course Experimental strategy and design Introduction to course 6BBA3012
Wedn Oct 6 th	Classroom 6 Hodgkin building 9am – 11am MRC Centre 4 th floor 11am - 1pm	Model systems to study nervous system development demonstrations
Wedn Oct 13 th	Classroom 6 Hodgkin building 9am – 1pm	The Great Debate Part 1
Wedn Oct 20 th	CAL lab 1.16 9 am – 10.30 am 10.30am – 1pm	Data handling and statistics demonstrations
Wedn Oct 27 th	Classroom 6 Hodgkin building 9am – 10am various locations 10am – 12am Classroom 6 Hodgkin building 12am – 1pm	Anatomy of a scientific paper paper discussion in small groups Tutorial on homework for 'Data handling and statistics'
Wedn Nov 3 rd	Classroom 6 Hodgkin building 9am – 1pm	The Great Debate Part 2
Nov 10 th	-----	reading week

Wedn Nov 17 th	Classroom 6 Hodgkin building 9am – 11am MRC Centre 4 th floor 11am – 1pm	In vitro systems used in developmental neurobiology Demonstrations
Wedn Nov 24 th	Classroom 6 Hodgkin building 9am – 1pm	Molecular-biological approaches in developmental neurobiology
Wedn Dec 1 st	Classroom 6 Hodgkin building and MRC Centre 4 th floor 9am – 1pm	Visualising neural development: techniques to study synapse function
Wedn Dec 8 th	Classroom 6 Hodgkin building 9am – 10am 10am – 12am Wolfson Centre 12am – 1pm	Feedback discussion Electrophysiological approaches to neuroscientific research demonstrations

COURSE ORGANISERS AND TUTORS

Course organiser:

Professor Uwe Drescher
phone 020 7848 6411
uwe.drescher@kcl.ac.uk
New Hunts House (NHH) room 4.26C

Co- organiser:

Professor Paul Francis
phone 020 7848 6269
paul.francis@kcl.ac.uk
Wolfson CARD

Course tutors:

Professor Sarah Guthrie
phone 020 7848 6535
sarah.guthrie@kcl.ac.uk
NHH room 4.08B

Dr Richard Wingate
phone 020 7848 6542
richard.wingate.kcl.ac.uk
New Hunts House room 4.04A

Dr Isabella Gavazzi
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Wolfson CARD

GUIDELINES FOR IN COURSE ASSESSMENTS

In this course you will be assessed via homework on 'data handling and statistics' (20%), a presentation (20%), and a two hour examination (60%).

Assessed homework on 'data handling and statistics'

Similar to tests done during the session 'data handling and statistics' on Oct 20th, you will be provided with data from a series of experiments and are expected to present them in the format of a scientific paper with particular emphasis on statistical aspects. You will be asked questions about the data and the conclusions that can be drawn. In order to do this you will have to choose appropriate statistical tests and be able to use the information provided by these tests. Deadline for submission of the homework will be Friday Oct 29th 2010 4pm (with a printout of your work at the Academic Centre and an email containing this work to Prof. Paul Francis (paul.francis@kcl.ac.uk)). We have included an additional tutorial on Wedn, Oct 27, 12am (classroom 6, Hodgkin Building), in which your questions on the homework will be addressed.

Guideline for assessed presentation

The assessed presentation is build around a 'GREAT DEBATE'. Two groups of two or three students will be given a topic from a list of themes which are being discussed controversially in the last years in the scientific community or/and which touch aspects of neuroscientific research in society. For each topic, the one group will present the PRO argument, while the other group will argue the case against, i.e. the CONTRA argument. Presentation time for each group is 15 minutes, being shared between the students in each group equally. In each case, the first speaker should give an introduction to the topic, the last one should summarise the arguments. The PRO and CONTRA presentations will be followed by a discussion between presenters, students and tutors, to clarify open questions.

The topics will be assigned to groups at the beginning of the course (a list of topics from the last years is given in Appendix 1). For each topic a tutor is available to help in researching and organising your presentation. You are encouraged to make use of this offer.

Students should present their site of the scientific controversy in a clear, balanced and concise way, using the features of PowerPoint to their advantage. They should 'defend' their topic in the best possible way, but it is clear that the arguments presented by the

individual students will not necessarily represent their personal convictions and belief. This is also the reason why the topics will be assigned and cannot be chosen by the students.

A handout of each presentation should be prepared and given to the audience containing key arguments and relevant references. This aspect is important as the topics and arguments discussed here will come up again in the EXAM.

All students are expected to attend both debate sessions, irrespective of whether they are involved in presenting.

Two hour examination

The 2h exam at the end of the course consists of a series of questions on topics presented in the lectures, as well as on themes discussed in the Great Debate. ALL lectures (apart from the Statistics lecture) as well as all topics presented in the demonstrations will be considered. Handouts will be provided by the lecturers; however these handouts only give an overview and thus do not cover all topics possibly addressed in the exam. Thus the attendance of all lectures and demonstrations as well as additional readings is required for a successful participation of this course. Exams of last year/s are placed on the webpage for the course

<http://virtualcampus.kcl.ac.uk/vc/kclonly/bsc/Anatomy/BA3009/index.html>

and also as Appendix 2 of this booklet.

DEADLINES

The deadline for submission of the statistics homework is Friday Oct 29th 2010 4pm. that is a printout of your work at the Academic Centre (Henriette Raphael Bldg. 1st floor) and an email containing this work to Prof. Paul Francis (paul.francis@kcl.ac.uk).

ATTENDANCE OF LECTURES

Handouts will be provided by the lecturers, however, these handouts only give an overview and do not cover all topics possibly addressed in the exam. Thus the attendance of all lectures and demonstrations as well as additional reading is required for a successful participation of the course.

PLAGIARISM

Plagiarism is the taking of another person's thoughts, words, results, judgments, ideas, images etc and presenting them as your own. For more information and how to avoid plagiarism, have a look at the Kings web page

<http://www.kcl.ac.uk/about/governance/acboard/examiners/assessment/plagiarism.html>

READING LIST

Recommended book for the course:

- **Principles of Neural Science**
by Eric Kandel, James Schwartz and Tom Jessell
[McGraw-Hill]

see also:

- **Development of the Nervous System**
by Dan Sanes, Thomas Reh and William Harris
[Elsevier - Academic Press]
- **Principles of Development**
by Lewis Wolpert
[Oxford University Press]
- **Fundamental Neuroscience**
by M Zigmond, F. Bloom, S. Landis, J. Roberts and L, Squire
[Academic Press]
- **Molecular Biology of the Cell**
by B. Alberts et al.
[Garland Science]
- **Statistical and data handling skills in biology**
Roland Ennos (5 copies in NHH library)

Please ask your lecturers for additional readings, if not already given in their presentations and handouts. Also, have a look at the web site of Neuroscience at King's @

<http://www.kcl.ac.uk/schools/biohealth/depts/neuroscience/> and of this course @

<http://virtualcampus.kcl.ac.uk/vc/kclonly/bsc/Anatomy/BA3009/index.html>

for further information, lecture Pdf etc.

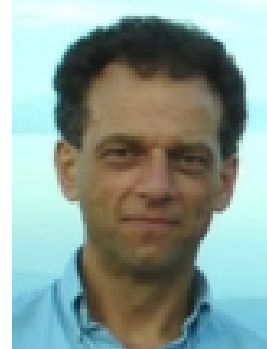
TIMETABLE WITH LEARNING OBJECTIVES

WEDNESDAY Sept 29th

Classroom 6
Hodgkin building

9am – 9.30am **Introduction to Course**
Uwe Drescher

9.30am – 11am **Experimental strategy and design**
Uwe Drescher



This lecture will describe selected aspects for the planning and carrying-out of laboratory research, including pitfalls and problems. It will be described how to formulate a hypothesis and how to design experiments to validate them. Albert Einstein's saying is discussed: "No amount of experimentation can ever prove me right; a single experiment can prove me wrong".

The 'scientific method' is introduced which refers to a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge.

Additionally, material for the preparation for the statistics lecture on Oct 20th will be given. Information on this will be available on Virtual Campus @

<http://virtualcampus.kcl.ac.uk/vc/kclonly/bsc/Anatomy/BA3009/index.html>

WEDNESDAY Sept 29th

Classroom 6
Hodgkin building

11am – 12am **Introduction to the course**
'Laboratory-based Research Project in Neuroscience' (6BBA3012)
Sarah Guthrie



WEDNESDAY Oct 7th

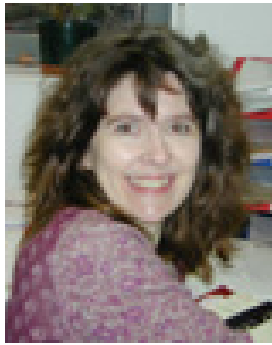
Classroom 6
Hodgkin building

9am – 11am

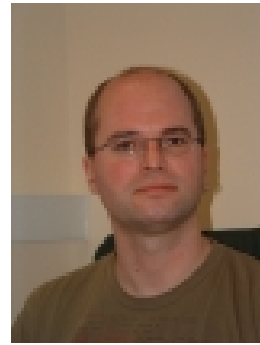
**Model systems to study nervous system development
(Drosophila, Zebrafish, Mouse)**



Julian Ng



Corinne Houart



Ivo Lieberam

Experts in their respective fields will discuss the use of particular model organisms in neurobiological research and describe the advantages and disadvantages of these systems, portray commonly used techniques, and give an overview of the major scientific achievements obtained within these model system. These lectures will provide guide lines for choosing an animal model system to investigate a particular scientific question.

WEDNESDAY Oct 7th

MRC Centre DevNeurobiol
4th floor NHH

11 – 1 pm

Practicals: Zebrafish as a model system
Corinne Houart's lab
Jon Clarke's lab

John Clarke

In the second part on model systems, a practical session will follow, consisting of demonstrations of techniques used to study neural development in Zebrafish, and the analysis of zebrafish mutants.



WEDNESDAY Oct 13th

Classroom 6
Hodgkin building

9am – 1pm

The Great Debate Part 1

WEDNESDAY Oct 20th

PAWS NHH, G12

9 am – 10.30 am

Data handling and statistics

Paul Francis

10am - 11 am

Demonstrations

Paul Francis and co-workers

11am – 12pm

free time to work on ‘practice problem’

12 – 1pm

Discussion of ‘practice problem’

Paul Francis



This session introduces the concepts of how to describe data statistically depending on the nature of the data, and then looks at ways of examining whether differences between groups can be attributed to chance or if there is a statistically significant difference. It is then up to the researcher to decide if it makes biological sense. There will then be a short introduction to the statistical programme on the PAWS machines called SPSS using some supplied data.

The deadline for submission of the statistics homework is Friday Oct 29th 2010 4pm (with a printout of your work at the Academic Centre (Henriette Raphael Bldg. 1st floor) and an email containing this work to Prof. Paul Francis (paul.francis@kcl.ac.uk).

We have included an additional tutorial on Wedn, Oct 27, 12am (classroom 6, Hodgkin Building), in which your questions on the homework will be addressed.

WEDNESDAY Oct 27th

Classroom 6
Hodgkin building

9am – 10am

Anatomy of a scientific paper
Uwe Drescher

various locations
10am – 12am

Tutor-guided discussion of a scientific paper in small groups
Kate Marler, Phillip Suetterlin, Paula Alexandre, Giovanna Lalli, Anna Clark, Thomas Butts

The principle anatomy of a scientific paper will be presented. Guidelines will be given how to approach, analyse and evaluate scientific papers and how to judge their 'quality'. Possibilities and procedures for funding will be portrayed.

Later, small groups of students will discuss individual papers, guided by a tutor. The format, clarity, content, importance, presentation of figures as well as possible flaws in these papers will be analysed.

12am – 1pm

Tutorial on homework for 'Data handling and statistics'
Marcus Leiwe, PhD student

In an additional tutorial to the lecture on statistics, your questions on the homework will be addressed.



WEDNESDAY Nov 3rd

Classroom 6
Hodgkin building

9am – 1pm

The Great Debate Part 2

WEDNESDAY Nov 17th

Classroom 6
Hodgkin building

9am – 11am

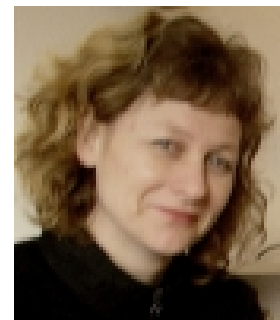
***In vitro* model systems used in developmental neurobiology**
Uwe Drescher

Tissue culture *in vitro* models are widely used in developmental neurobiology research. In this tutorial the variety of *in vitro* approaches that can be employed will be discussed, including their advantages and disadvantages, and their relevance to various areas of neurobiological study. Among the examples to be included will be organotypic cultures, collagen gel co-cultures, dissociated neuronal cultures as well as collapse-, turning- and stripe-assays and their use to assess the role of molecules controlling cell migration and axon guidance.

MRC Centre DevNeurobiol
4th floor (NHH)

11am – 1 pm

Demonstration of *in vitro* approaches
Uwe Drescher's lab
Britta Eickholt's lab



Britta Eickholt

WEDNESDAY Oct 14th

Classroom 6
Hodgkin building

9am – 1pm

**Molecular-biological approaches
in neurobiology**
David Chambers



Some of the molecular techniques currently used to investigate developmental neurobiology will be discussed, together with information about how to find out more about these techniques and interpret them when encountered in scientific papers. These techniques will include: mRNA in situ hybridisation, RT-PCR on embryos, in vivo gene overexpression and knock-down, and the generation of transgenic mice.

An outline will be provided of contemporary techniques in screening GENE ARRAYS, to search for genes involved in specific developmental processes and the development of specific cell types. Technical and experimental design considerations and strategies in using databases to search for candidate genes and to investigate gene function will be explained.

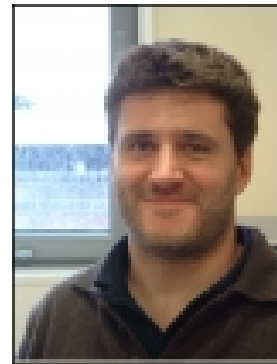
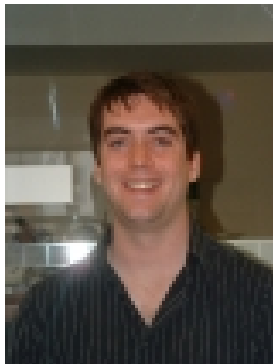
WEDNESDAY Dec 1st

MRC Centre Dev Neurobiol
4th floor

9am – 1 pm

**Visualising neural development and
Techniques to study synapse function
(tutorials and presentations)**

Richard Wingate, Matt Grubb, Juan Burrone



The modern era of neurobiology began with the visualisation of individual neurons in the late nineteenth century. This was achieved by a combination of practical advances in light microscopy, tissue fixation and staining techniques. Microscopy still lies at the heart of neuroscience and this session will introduce basic concepts and recent advances in techniques. Students will be able to

- assess the historical significance of microscopy in neuroscience
- relate the basic principles of light microscopy
- explain the principles of fluorescence and confocal microscopy
- evaluate the application of time-lapse approaches
- reflect on the application of advanced methods of fluorescence excitation, transfer and decay in physiological experiments

Additionally, ways to study neuronal function, from synapses right up to behaviour will be presented. Techniques discussed will include synaptic functional imaging with calcium dyes and synaptopHluorin, patch clamp and extracellular recording of electrical activity, behavioural tests in the lab, and ways to extend all (or at least most) of these approaches to human subjects.

Wednesday Dec 8th

Classroom 6
Hodgkin building

9am – 10am

Feedback discussion
Students and course organisers

10am – 12am

**Electrophysiological
approaches to neuroscience
research**
Jon Robbins



The brain uses electrical activity to encode information and to control the rest of the body. Understanding the electrical activity of the nervous system has gone a long way to help us understand how the brain works. From the early experiments of Galvani (1780s) through the Nobel Prize winning work of Hodgkin and Huxley (1950s) and Neher & Sackmann (1980s) modern electrophysiological techniques can record the electrical activity of the whole brain, discrete areas, individual cells, single synapses and individual molecules. The lecture will highlight the different techniques used to record electrical activity from the nervous system including:

- Electroencephalogram
- Evoked potentials
- Extracellular recordings
- Intracellular recordings
- Single channel patch clamp

Wolfson Centre
12am – 1pm

Demonstrations
Jon Robbins and colleagues

You will be guided through labs in Wolfson CARD working on neuroscientific topics using electrophysiological approaches.

Appendix 1

Selection of topics for the GREAT DEBATE from the last years.

The actual topics will be assigned at the beginning of the course.

Neural stem cell therapy

PRO: Neurological diseases will be cured by neural stem cell transplantation

vs.

CONTRA: In the foreseeable future it will not be possible to cure neurological diseases using neural stem cell transplantations.

Autism research

PRO: Neurobiologists should seek to understand the genetic causes of autism.

vs.

CONTRA: Investments into genetic research on autism is better used for behavioural therapies to cure autistic children.

Role of A-beta in Alzheimer's disease

PRO: The clinical and pathological features of Alzheimer's disease can be explained entirely by reference to Aβ accumulation.

CONTRA: Preventing the hyper-phosphorylation of tau in the pre-symptomatic stage of Alzheimer's disease will be disease halting.

neuromarketing

PRO: Neuromarketing has a sound scientific basis and will fundamentally change the way in which products are designed, promoted, priced, and packaged.

vs.

CONTRA: Neuromarketing has little scientific basis and is ethically highly problematic

translational research

PRO: An understanding and curing of neurological diseases is best achieved by basic scientific research.

vs.

CONTRA: An understanding and curing of neurological diseases is best achieved by applied (translational) research.

Treatment of spinal cord injuries

PRO: Findings provided by basic research using animal systems have sufficiently advanced to initiate treatments to cure spinal cord injury on human patients

vs.

CONTRA: Basic research has not provided sufficient data derived from model systems justifying the deployment of therapies for curing spinal cord injuries in humans

Appendix 2

Exam questions April 2009/2010

(6 out of these 8 questions had to be chosen)

1. Describe the spectrum of electrophysiological approaches that enable the recording of the activity of a single molecule up to the recording of the conscious brain.
2. What do you think is the most important contribution given so far by basic science to the search for a cure for the consequences of a spinal cord injury? What do you think is its main limitation?
3. Describe forward genetics in zebrafish. Explain how scientists identify the genetic lesion related to the phenotype selected. Discuss the reasons why reverse genetics (targeted mutagenesis) is not done in zebrafish.
4. Explain how the UAS/GAL4 system works and how it can be used in neurobiological studies.
5. Discuss the problems associated with the application of ES cell technology for curing human diseases.
6. Describe the principle of the Campenot chamber. Give an example where this assay system has been used to address a biological question.
7. Describe the structure of a typical scientific paper. Discuss the advantages and disadvantages of this structure.
8. What are the advantages of using fluorescence in microscopy?