CNWY40120 - Advanced Biological Imaging (Live Module Details) 2011/12

General Information

Subject Area:	Conway Institute	Short Title:	Advanced Biological Imaging
Semester:	SEM_1	Long Title:	Advanced Biological Imaging
Module Coordinator:	Dimitri Scholz	School:	Conway Institute
Level:	4	Credits:	5
Module Status:	Submitted for Review	Passing Grade:	DPF%
Available on Blackboard:	Yes		

Module Places

Overall Places:	40	Core / Options:	40	General Elective:	0
		In-Programme:	0	International:	0

Module Description:

This module is designed for students who wish to understand and become critically aware of the principles, practice and applications of rapidly developing imaging technologies. Particular focus is given to white and fluorescent light-based imaging approaches. A series of lectures will inform about the concepts of imaging and microscopy; application of histology, immunohistochemistry and immunofluorescence; basics of confocal microscopy, light sheet microscopy, super resolution microscopy, multi-photon microscopy, high content screening microscopy; techniques in light microscopy and live cell imaging; and also the relationship between light microscopy and electron microscopy.Lecture 1 - Introduction - DSPrinciples of biological imaging, basic history of imaging and instrumentation, photon efficiency, spatial and temporal resolution, Nyquist, Abbe, basics of optical components and light pathsLecture 2 - Microscope components - DSMicroscope body configurations, optical elements, light sources, lasers, excitatio n and emission filters, dichroic mirrors, AOTFs, scanners, detectors, cameras, PMTs, objectivesLecture 3 - Bright field microscopy - DSBasic principles, methods of contrast formation and enhancement, total internal reflection microscopy (TIRM), Koehler illumination, phase contrast, DIC, Wollaston prism, Nomarski prism, dark field microscopyLecture 4 - Histology - DSApplications, fixation methods, tissue processing, embedding, sectioning, staining and stains available, artefactsLecture 5 - Immunohistochemistry - DSSample preparation, direct and indirect immunohistochemistry, double- and multiple labelling, noise and tools for noise reduction, cryo-sections, paraffin and resin sections, immunolabelling, slide mounting and storageLecture 6 - Fluorescence - JCSPrinciples of fluorescence, Jablonski diagrams, fluorescent dyes and chemicals, immunofluorescence, GFP and variants, DsRed and variants, basics of fluorescence light microscopyLecture 7 - Confocal microscopy - JCSPrinciples of confocal microscopy, wide-fi
eld versus confocal microscopy, optical sectioning, point scanner and Nipkow disk-based confocality, confocal microscope componentsLecture 8 - Light sheet microscopy - EGRPrinciples of light sheet (LS) microscopy, description of possibilities and instrumentation available (SPIM, DSLM, OPFOS, TSLM), sample preparation for 3D microscopy, basic concepts of 3D image handling and processingLecture 9 - Super resolution microscopy - EGRHow to improve resolution in fluorescence microscopy, illumination based approaches (structured illumination (SI)), acquisition based approaches (STED, PALM, STORM)Lecture 10 - High content screening microscopy - JCSPrinciples of automated microscopy, technologies involved, instrumentation available, limitations, autofocus, image acquisition, image analysis, application in cell-based screeningLecture 11 - Multi-photon microscopy - Saak Ovsepian (DCU)Principles of multi-photon microscopy, image acquisition, image analysis, technologies involved, instrumentation available, application
in biomedical research, limitationsLecture 12 - Techniques to measure protein mobility - JCSIntroduction to cell and protein mobility techniques, live cell imaging, photobleaching, FRAP, FLIPLecture 13 - Techniques to measure protein interactions - DSIntroduction to protein-protein techniques in microscopy, FRET, FLIM, FCS, FCCSLecture 14 - Ultrastructural imaging - DSOverview of ultrastructural techniques, scanning electron microscopy,

transmission electron microscopy, EM instrumentation, basics of sample preparationLecture 15 - Correlative light-electron microscopy - DSOverview of techniques, basics of sample preparation, CLEM applications and examplesLecture 16 - Image processing - EGROverview of image processing, basics of image analysis, tools and software available, deconvolution, image presentationPractical 1 - Bright field microscopy (DS)Practical 2 - Immunohistochemistry / basic fluorescence microscopy (DS)Practical 3 - Point scanning confocal microscopy (JCS)Practical 4 - High content screening mic

roscopy (JCS)Practical 5 - Live cell imaging (spinning disk microscopy) (DS)

Learning Outcomes:

On completion of this module students will have extensive insight into the variety of light microscopes available and associated techniques that can be applied in the study biological samples.

Workload

Type	Workload
Specified Learning Activities	15
Lectures	18
Autonomous Student Learning	67
Total	100

Assessment Strategies

Description	Timing	Score-by	% Final Grade	In Blackboard
Presentation	UNSPECIFIED	Letter Grade	80	No
Students are required to attend and participate fully in lectures	UNSPECIFIED	Letter Grade	20	No

Prior Learning - Recommended:

It is recommended that students have completed CNWY40090 Introduction to 'Omic' & Advanced Imaging Technologies prior to registering for this module.

Resits

Resit Type	Duration - Hours	Timing Weeks
In-semester assessment		

Remediation Strategies:

If you fail this module you may repeat, resit or substitute where permissible