# Preclinical Imaging

**Semester 1 / Autumn**

10 Credits

Each Course is composed of Modules & Activities.

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Each Module is composed of Lectures, Reading Lists, MCQ self-assessments, & Discussion Boards.

These Modules are taught on the following Programmes, or are incorporated into blended Courses which teach students enrolled outwith the Edinburgh Imaging Academy:

- IMSc - Imaging programme
Edinburgh Imaging Academy – online distance learning courses

**Modules are:**

**Introduction to Preclinical Imaging:**
- Preclinical imaging - introduction

**Legislation and ethics governing the use of animals in research in the UK:**
- Animals in Research – Moral and ethical considerations
- Animals in Research – UK legislation

**Practical considerations of preclinical MR imaging:**
- Practicalities of Preclinical MRI
- Preclinical cardiac MRI

**Preclinical MR case studies:**
- Assessment of myocardial viability using 23Na MRI
- Conscious rodent fMRI
- Imaging the healing murine myocardial infarction: ultrasound, MRI and near-infrared fluorescence

**Practical considerations of Preclinical Ultrasound:**
- Introduction to preclinical ultrasound imaging

**Preclinical US case study:**
- Preclinical US (embryonic heart)

**Practical considerations of Preclinical optical techniques:**
- Pre-clinical optical in vivo imaging

**Practical considerations of Preclinical PET imaging:**
- microPET and microSPECT imaging

**Experimental imaging:**
- Overview
- Applications

**Zebrafish as an animal model:**
- The anatomy and natural history of zebrafish
- The application of Zebrafish: Imaging in Biodmedical Research
Introduction to Preclinical Imaging

Lecture 1
Title: Preclinical imaging - introduction
Description: Introduction
Author(s): Dr. Maurits Jansen
Learning Objectives
- Explain different preclinical imaging modalities
- Compare these imaging modalities and highlight advantages and disadvantages of each of them
- Give examples of applications

Legislation and ethics governing the use of animals in research in the UK

Lecture 1
Title: Animals in Research - Moral and ethical considerations
Description: Moral and ethical considerations of animal in research
Author(s): Dr Carmel Moran
Learning Objectives
- Discuss the moral and ethical dilemmas associated with animal research
- Describe the use of animals in research from a statistical and historical perspective

Lecture 2
Title: Animals in Research – UK legislation
Description: Overview of UK legislation governing the use of animals in research
Author(s): Dr Carmel Moran
Learning Objectives
- Highlight the key features of the UK’s Animal Scientific Procedure Act 1986
- Explain terminology used in this legislation
- Explain the concept of 3Rs
- Highlight the 2012 amendments to bring UK national legislation into full compliance with the European directive
Practical considerations of preclinical MR imaging

Lecture 1
**Title:** Practicalities of Preclinical MRI  
**Description:** Example of a preclinical MRI study; Preclinical MRI vs. clinical MRI  
**Author(s):** Dr. Maurits Jansen  
**Learning Objectives**  
- Explain the example of a preclinical MRI study  
- Highlight issues specific to preclinical MRI as compared to clinical MRI  
- Discuss solutions to common problems

Lecture 2
**Title:** Preclinical cardiac MRI  
**Description:** Translational medicine; Non-invasive MRI; Cardiac MRI in rodents  
**Author(s):** Dr. Maurits Jansen  
**Learning Objectives**  
- Interpret cardiac MRI use & application of in rodents  
- Highlight some issues concerned with rodent cardiac MR
Preclinical MR case studies

Lecture 1
Title: Assessment of myocardial viability using 23Na MRI
Description: Case study
Author(s): Dr. Maurits Jansen
Learning Objectives
- Give an overview of the techniques used for assessment of myocardial viability
- Explain the usage and usefulness of 23Na MRI for the assessment of myocardial viability
- Describe the advantages and disadvantages of 23Na MRI

Lecture 2
Title: Conscious rodent fMRI
Description: Pre-clinical animal research, translational utility, techniques
Author(s): Dr. Nichola Brydges
Learning Objectives
- Describe functional magnetic resonance imaging (fMRI)
- Evaluate conscious fMRI in pre-clinical animal research
- Give an overview of the development of
  - conscious rodent fMRI procedures
  - rodent fMRI analysis

Lecture 3
Title: Imaging the healing murine myocardial infarction: ultrasound, MRI and near-infrared fluorescence
Description: Possibilities and limitations with in vivo imaging for studying myocardial infarctions.
Author(s): Dr. Gillian A Gray
Learning Objectives
- Explain basic pathology of myocardial repair & remodelling after myocardial infarction (MI)
- Explain the usefulness of in vivo imaging as a research tool in experimental models
- Describe murine coronary artery ligation as an experimental model for investigating MI
- Describe possibilities & limitations of in vivo imaging for investigation of murine myocardial repair & remodelling
- Explain practically how to image myocardial infarct & its potential for translation to clinical studies
Practical considerations of Preclinical Ultrasound

Lecture 1
Title: Introduction to preclinical ultrasound imaging
Description: Practical preclinical ultrasound imaging
Author(s): Dr Carmel Moran

Learning Objectives
- Describe equipment used in preclinical ultrasound
- Explain terminology used in ultrasound imaging
- Highlight advantages & disadvantages of ultrasound imaging over other preclinical imaging techniques
- Describe examples of preclinical ultrasound imaging studies

Pre-clinical US case study

Lecture 1
Title: Preclinical US (embryonic heart)
Description: The importance of glucocorticoid action in foetal heart development
Author(s): Dr. Eva Rog-Zielinska, Prof Karen Chapman

Learning Objectives
- Describe the importance of glucocorticoid action in fetal heart development
- Interpret the cardiac phenotyping of glucocorticoid receptor knock-out (GR-/-) fetal mice by non-invasive in utero ultrasonography

Practical considerations of Pre-clinical optical techniques

Lecture 1
Title: Pre-clinical optical in vivo imaging
Description: Optical imaging, reagents & applications
Author(s): Dr Paul M Fitch, Dr Marc Vendrell & Adrian Thomson

Learning Objectives
- Define the two methods of optical in vivo imaging
- Describe some of the reagents currently available for bioluminescence imaging and their application
- Describe some of the reagents currently available for fluorescence imaging and their application
- Highlight the key advantages and limitations of optical in vivo imaging
Practical considerations of Preclinical PET imaging

Lecture 1
Title: microPET and microSPECT imaging
Description: Preclinical PET, SPECT imaging, and examples of applications in preclinical research
Author(s): Dr. Adriana Tavares, Dr. Alison Fletcher
Learning Objectives
• Define molecular imaging - PET and SPECT
• Describe physics principles associated with molecular imaging
• State main applications of PET and SPECT imaging
• Explain the radiotracer principle
• Identify & describe key aspects associated with preclinical PET and SPECT imaging

Experimental imaging

Lecture 1
Title: Overview
Description: Overview of preclinical imaging
Author(s): Dr. Maurits Jansen
Learning Objectives
• Understand differences between small animal and human imaging
• Know how MR experiments are performed in animals
• Understand applications of cardiac cine MR in animals

Lecture 2
Title: Applications
Description: Recent applications & techniques
Author(s): Dr. Maurits Jansen
Learning Objectives
• Know what is meant by cell tracking
• Describe examples of experimental imaging
• Describe the term molecular imaging
• Describe manganese enhanced MR
Zebrfish as an animal model

Lecture 1
Title: The anatomy and natural history of zebrafish
Description: The fundamental anatomy of zebrafish and the advantages of this model organism in biomedical research
Author(s): Dr. Carl Tucker
Learning Objectives
- Describe the anatomy and natural history zebrafish in biomedical research
- Explain the significance of the natural history of the zebrafish and its importance in biomedical research
- Interpret the comparative genetic, cellular and physiological processes that exist between zebrafish and mammals

Lecture 2
Title: The Application of Zebrafish: Imaging in Biomedical Research
Description: Methodologies employed with zebrafish in biomedical pre-clinical research
Author(s): Dr. Carl Tucker
Learning Objectives
- Explain the benefits of Genetically-Modified zebrafish in biomedical research
- Give an overview of the applications of Genetically-Modified zebrafish in biomedical research
- Describe observable morphological changes, as well as assessments of organ function