ICR The Institute of Cancer Research

MSc in Oncology

Including PG Certificate and PG Diploma

Cell and Molecular Biology of Cancer

Module Guide 2019/20

Part A | Basic Sciences

UNIVERSITY OF LONDON

Contents

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The information contained in this Module Guide is correct at the time of going to press. Any amendments relating to the course or changes to published dates will be announced to students via Canvas, the course virtual learning environment. Information found on Canvas will always be the most accurate and up to date information available. Where anything in this guide contradicts the ICR Academic Regulations, the ICR Academic Regulations take precedence.

1 Module details

1.1 Module overview

This module will allow you to better understand the molecular and cellular processes underlying the development of cancer, and will enable you to put this knowledge to use in clinical practice. The topics covered are wide, ranging from the hallmarks and causes of cancer, to tumour genetics and immunology of cancer.

The module is compulsory and is taken in Part A of the course. Lectures take place over ten weeks during the first semester, and assessment takes place at the end of the module.

1.2 Module specification

Cell and Molecular Biology of Cancer	
Full Title:	Cell and Molecular Biology of Cancer
Part of Course:	Part A: Basic Sciences
Compulsory or optional:	Compulsory
ICR Reference Number:	MS1008
Academic Level:	Level 7 (Masters)
Credit Value:	20 Credits

2 Contact information

2.1 General enquires

Students are advised to contact the MSc course team regarding any administrative matters at *mscadministrator@icr.ac.uk*. Any academic matters should be forwarded to the Course Director, Module Leaders or Lecturers as appropriate.

2.2 Key people

Name	Contact Information
Course Director	
Dr Rema Jyothirmayi Consultant Clinical Oncologist, ICR/RMH	*rema.jyo@nhs.net*
Module Leaders	
Dr Nicola Valeri Team Leader, GI Cancer Biology & Genomics group / Consultant Medical Oncologist, ICR/RMH	*nicola.valeri@icr.ac.uk*
Dr Dragomir Krastev Senior Scientific Officer, Gene Function group, Breast Cancer Research, ICR	*dragomir.krastev@icr.ac.uk*
Dr Ben O'Leary Academic Clinical Lecturer, Breast Cancer Research - Molecular Oncology, ICR	*Ben.Oleary@icr.ac.uk*

3 Module structure and aims

3.1 Aims

The module aims to guide you to acquire and develop an awareness and appreciation of the molecular and cellular processes underlying the development of cancer; and synthesise the lectures and knowledge into clinical practice.

3.2 Learning objectives

This module will allow students to:

- Develop a critical awareness and appreciation of the cellular and molecular features of malignancy with a critical awareness of recent developments and current research directions;
- Develop a critical awareness of the common and novel laboratory techniques used in order for the student to be able to evaluate and critically analyse research findings;
- Develop a core of knowledge to enable the student to critically evaluate and analyse current and future research in cancer biology and its translation to cancer medicine;
- Develop a basic knowledge of the importance of host-tumour interactions;
- Appreciate the implications of new paradigms in tumour dissemination such as cancer stem cells, non-coding RNA and epigenetic modulation of gene expression, cancer metabolism, tumour heterogeneity and clonal evolution;
- Understand the basics of molecularly targeted cancer therapy and the importance of predictive and prognostic biomarkers.

3.3 Structure

This module is a core module for Part A of the Postgraduate Certificate / Postgraduate Diploma / MSc in Oncology course. Students should attend all lectures to prepare themselves for the end of module assessments.

This module also features the opportunity to visit some ICR laboratories to see how some of the techniques you will have learnt about are carried out. Students will visit four laboratories in the ICR's Chester Beatty Laboratories in Chelsea, hosted by the research scientists who work in them. These visits will take place on the last teaching session of the module.

A full and up to date module timetable, including the date of the laboratory visit, is available in the calendar on Canvas. Any changes to this schedule will be announced through Canvas notifications.

4 Syllabus content

4.1 Core syllabus content

The module is based upon the key 'Hallmarks of Cancer' expounded by Hanahan and Weinberg. The key subjects covered are therefore:

- General principles of tumour biology
  - DNA, RNA and proteins and their importance in studying cancer biology;
  - the cell cycle and basic cell kinetics, including parameters associated with cell cycle.
- The genetics of normal and malignant cells
  - normal chromosomal structure/function, gene transcription, DNA repair mechanisms;
  - gene polymorphisms, mini and microsatellites;
  - genome instability, gene amplification and deletion.
- Epigenetics, chromatin structure and function
  - methylation, hypomethylation and methylation reversal;
  - chromosomal and genetic changes in malignancy;
  - oncogenes, proto-oncogenes, tumour suppressor genes (including discussion of well -established examples in each class);
  - protein-protein interactions;
  - normal and aberrant mechanisms of cell growth control.
- Normal and aberrant mechanisms of cell growth control
  - control of normal cell growth and behaviour;
  - altered expression, function and control of these mechanisms in malignancy;
  - the role of mitotic kinases;
  - gene promoters and their activity in normal and malignant cells.
- Techniques in molecular biology
  - nucleic acid analyses including electrophoresis, hybridisation, blotting, PCR, sequencing, transfection;
  - micro array techniques;
  - protein and phosphoprotein assays (western blot, ELISA).

- Causation of human cancers
  - carcinogenesis, causative factors and interaction with DNA repair.
- Cancer genetics
  - inherited syndromes associated with cancer;
  - genes conferring susceptibility to cancer and mechanisms whereby such genes can be associated with neoplasia.
- Cancer progression
  - multistep oncogenesis, cancer initiation and evolution;
  - mechanisms involved in oncogenesis focusing on events at the cellular level including loss of differentiation, neoangiogenesis, adhesion;
  - hypoxia: biology, role in cancer progression and treatment resistance;
  - invasion, cell motility, metastasis, host/tumour interactions, patterns of metastasis;
  - cancer and host immune response. Using gene therapy and immunotherapy to treat cancer;
  - biomarkers of response to therapy: using circulating cells and DNA, biopsies, surrogate tissues, body fluids, non-invasive imaging.
  - genome editing technologies (e.g.CRISPR) for the characterisation of novel genes and variants and as cancer treatment.

5 Assessment

5.1 Assessment overview

Both formative and summative assessment methods will be used in this module. All students must complete both types of assignment. Please refer to the Assessment section on Canvas or in the Student Handbook for more guidance on more general aspects of assignment submission.

5.2 Formative single best answer test

For this module, all students will sit a compulsory single best answer (SBA) test. This SBA must be passed in order to pass the module overall, but the score will not contribute to the overall module mark.

The test is taken on Canvas and will consist of 25 questions, each scoring 10 points. You must score at least 50% (130 points) to pass. You have two attempts at this test and your highest score will be recorded. The SBA must be completed within 45 minutes.

5.3 Summative assignment

This module is assessed via an essay of **strictly up to 1,500 words**.

Your essay must be based on one of a selection of essay titles which will be allocated to students during the module. For each, you will relate the biological features of cancer to a clinical scenario.

The essay will be used to assess the depth of your understanding of a specific aspect of Cell and Molecular Biology, along with your ability to critically appraise data and to demonstrate its relationship and relevance to a clinical environment. Essays should relate to the basic sciences you will have learnt about during the year.

You are strongly encouraged to use simple diagrams or line drawings in your text. Hand drawn diagrams are acceptable but will need to be scanned in to your electronic submission. Be sure to also include relevant references to journal papers where appropriate. **Remember that penalties will apply for any work that is late, over the word limit, or includes plagiarised material.**

Submit your essay via Canvas following the instructions in the Student Handbook. Ensure you submit the same essay to both markers that correspond to the question you have answered.

6 Learning resources

6.1 Learning resources

The following learning resources are relevant to this module:

Main key papers

You are strongly advised to read the following key papers:

- Hallmarks of Cancer: The Next Generation. Hanahan, Weinberg. (2011) Cell. 4(5):646-674
- Cancer and Its Management, 6th Edition. Souhami, Tobias. (2007) John Wiley And Sons Ltd.Practical Clinical Oncology. Hanna, Crosby, Macbeth. (2008) Cambridge.

Additional key papers

Students are encouraged to read these papers:

- Intrinsic Tumour Suppression. Lowe, Cepera, Evan. (2004) Nature. 432:307-315
- Cancer genes and the pathways they control. Vogelstein, Kinzler. (2004) Nature Medicine. 10:789-799
- Chemotherapy and the war on cancer. Chabner, Roberts. (2005) Nature Reviews Cancer. 5:65-72
- Cancer immunotherapy – revisited. Lesterhuis W, Haanen J, Punt C. (2011) Nature Reviews Drug Discovery. 10:591-600
- Past, present and future of molecular and cellular oncology. Lorenzo G, Vitale I, Guido K. (2011) Frontiers in Oncology. 1:1
- The grand challenges to cellular and molecular oncology. Galluzzi L, Kroemer G. (2011) Frontiers in Oncology. 1:1
- Cell death signaling and anticancer therapy. Galluzzi L, Vitale I, Vacchelli E, Kroemer G (2011) Frontiers in Oncology. 1:1
- The 100,000 Genomes Project Protocol v3, Caulfield M et al. (2017) Genomics England. doi:10.6084/m9.figshare.4530893.v2. 2017.

Core texts

You are strongly advised to read the following key textbooks:

- The Biology of Cancer, 2nd edition. Weinberg RA. (2013) Garland Science
- Cancer Biology, 4th edition. Ruddon RW. (2007) Oxford University Press
- The Molecular Biology of Cancer: A Bridge from Bench to Bedside, 2nd edition. Pelengaris ES, Khan M. (2013) Wiley-Blackwell
- Cancer Biology, 3rd edition. King, Robins. (2006) Prentice Hall
- The Basic Science of Oncology, 5th edition. Tannock, Hill et al. (2013) McGraw-Hill Medical
- Introduction to the Cellular and Molecular Biology of Cancer, 4th edition. Knowles, Selby. (2005) Oxford University Press

Other reading

- Cancer Medicine Review, 6th edition. Kufe, Pollock, Weischbaum, et al. (2003) BC Decker
- The Genetic Basis of Human Cancer, 2nd edition. Vogelstein, Kinzler. (2002) McGraw-Hill Education
- Molecular Biology of the Cell, 6th edition. Alberts, Johnson, Lewis, et al. (2014) Garland Science
- Molecular Cell Biology, 7th edition. Lodish, Berk, Kaiser, et al. (2012) Palgrave Macmillan
- Oxford Textbook of Oncology, 2nd edition. Souhami, Tannock, Hohenberger, Horiot. (2001) Oxford University Press
- Lewin's Genes XI, 11th edition. Krebs, Goldstein, Kilpatrick. (2014) Jones & Bartlett
- Genetic Predisposition to Cancer, 2nd edition. Eeles, Easton, Ponder, Eng. (2004) CRC Press
    - A Beginner's Guide to Targeted Cancer Treatments Paperback –: Elaine Vickers(2018) Wiley Blackwell
-
- Liquid biopsies come of age: towards implementation of circulating tumour DNA. Wan JCM et al. Nat Rev Cancer (2017)

    Genome Editing: Past, Present, and Future. Carroll D. Yale J Biol Med. (2017)

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