LIFE SCIENCES AND BIOMEDICAL TECHNOLOGY

UNIVERSITEIT GENT

POST-ACADEMIC COURSE

25 MARCH 2015 – 17 JUNE 2015

"Life sciences" is a broad field encompassing different disciplines and expertise, involving biologists, geneticists, biomedical scientists, medical doctors as well as bio- and biomedical engineers and computer scientists. Biomedical technology has acquired a key position in our rapidly evolving high-tech society. In medicine, "translational medicine" has become the new credo; a fast and targeted "translation" of novel insights and findings from basic sciences into clinical practice is envisioned. This should ultimately result in faster application of advanced preventive, diagnostic and therapeutic applications, personalised and tailored to the specific needs of the individual patient. This novel perspective provides opportunities, both for fundamental research as well as for its translation into medical and industrial applications. The interaction between (molecular) biology and medical technology (micro-electronics ICT, biomechanics) has led to disruptive and groundbreaking applications in medicine and healthcare.

The aim of the lecture series on "Life Sciences and biomedical technology" is to provide to the student, in an accessible and comprehensive way, the essentials of life sciences. Departing from knowledge at the molecular level, we will gradually build up living matter from the micro- (subcellular molecules) to the macro-level (organ and system level), with obviously large attention for the cell and tissue level. Insight will be provided into the molecular and cellular processes that are at the basis of the functioning of the organism, into how genetic information is stored in these cells and how it is coded to synthesize proteins, into cell-cell communication, et cetera. We surpass the descriptive level and update students on recent techniques for the quantitative and qualitative analysis of cells and tissues, with particular attention for the interaction between biology and informatics (bio-informatics), a relatively novel field that emerged from the need for tools for the processing and interpretation of the enormous amounts of data resulting from, for instance, genome analysis.

Who should attend?

The lecture series aims for engineers/physicists (working in industry, government, research,…) with an interest in the broad domain of life sciences, but lack the basic knowledge required to fully grasp the field or to deploy professional activities in the biomedical sector.

At the same time, "Life Sciences and biomedical technology" equally aims for specialists in the field who wish to update their knowledge and get acquainted with the state-of-the art in life sciences and its quantification and analysis tools.

Post-academic Course Certificate granted by Ghent University

To receive a certificate, one should attend all the lessons and succeed for the exam.

Scientific Coordination

- Prof. Sofie Bekaert, Bimetra-Clinical Research Center Ghent, Faculty of Medicine and Health Sciences, Ghent University
- Prof. Patrick Segers, Institute Biomedical Technology, Faculty of Engineering and Architecture, Ghent University

Teachers

- Marc Bracke, Department of Radiation Oncology and Experimental Cancer Research, Ghent University
- Ria Cornelissen, Department of Basic Medical Sciences, Ghent University
- Martine De Vos, Department of Internal Medicine, Ghent University
- Winnok De Vos, Department of Molecular Biotechnology, Ghent University & Department of Veterinary Sciences, University of Antwerp
- Jan Gettemans, Department of Biochemistry, Ghent University
- Godelieve Gheysen, Department of Molecular Biotechnology, Ghent University
- Filomeen Haerynck, Department of Clinical Chemistry, Microbiology and Immunology, Ghent University
- Geert Leroux-Roels, Department of Clinical Chemistry, Microbiology and Immunology, Ghent University
- Tom Taghon, Department of Clinical Chemistry, Microbiology and Immunology, Ghent University
- Wim Van Criekinge, Department of Mathematical Modelling, Statistics and Bio-informatics, Ghent University
- Tom Van de Wiele, Department of Biochemical and Microbial Technology, Ghent University
- Mario Vaneechoutte, Department of Clinical Chemistry, Microbiology and Immunology, Ghent University
- Christian Vanhove, Department of Electronics and Information Systems, Ghent University
- Nadine Van Roy, Department of Pediatrics and Medical Genetics, Ghent University

PROGRAMME

1. Architecture and structure of cells

This first session deals with the architecture, structure and organisation of individual cells, as the smallest units of an organism. The following topics are covered: the organisation within the cell, the difference between prokaryotic and eukaryotic cells, the elementary building blocks of the cell, biological membranes, …

Date: 25 March 2015
Teacher: Winnok De Vos

2. Energetic and metabolic aspects of cells

In this second session, an extensive overview will be given of:

- energetic processes within the cell: electron transport and functionality (role of ATP, phosphorylation, photosynthesis)
- enzymes as catalysts within the cell
- biochemistry and biochemical processes: aerobic and anaerobic processes and photosynthesis

Date: 1 April 2015
Teacher: Jan Gettemans

3. Hereditary information – on DNA and genes

This third session focusses on hereditary information and characteristics, and outlines how heritable traits and characteristics are stored within each cell, how this information is transmitted onto next generations, and how these are expressed. In addition, mechanisms of control of gene expression are explained.

Date: 22 April 2015
Teacher: Nadine Van Roy

4. From cell to tissues – techniques for analysis

Cells with similar shapes and function are organised into tissues. Four primary tissues can be distinct in an organism, and their most important properties and specific components will be discussed during this lecture. A next level of organisation of tissues results in the formation of organs, interactions between organs ultimately enables the development of an entire system.

In order to render cells and tissues observable under the microscope, they undergo a number of manipulations and preparations that can be summarised as "histological techniques". In the second part of this session, we will review the most recent and state-of-the art light microscopy based techniques to visualise cells (and subcellular components) and methods for the quantitative and qualitative analysis of these images. Their role and relevance in the contemporary life sciences research is discussed.

Date: 29 April 2015
Teachers: Ria Cornelissen & Winnok De Vos

5. Gene technology and molecular diagnostics

This session offers an overview of methods and techniques applied to genetically modify organisms (gene technology) and demonstrates how organisms are identified and their traits and characteristics are analysed (molecular diagnostics).

Topics covered in the gene technology part include: how to clone DNA ? How to modify and add genes to the DNA of an organism (transformation)? How to enhance or inhibit (knock out) expression of specific characteristics of the organism ? There will be examples for micro-organisms, plants and animals.

Topics treated in molecular diagnostics encompass: the newest generation mass sequencing technologies that allow fast analysis of the entire DNA of an individual ; Proteomics: rapid and inexpensive techniques to analyse proteins.

Finally, the diagnostic power of epigenetic markers is elucidated, one of the recent revolutions in diagnostics. Most often tumor cells not only have mutations in the DNA but also dysregulations in the gene expression. These dysfunctions cannot be detected at the DNA level, but rather require epigenetic analysis and screening.

Date: 6 May 2015
Teacher: Godelieve Gheysen

6. Oncology

Invasive growth and metastasis are crucial mechanisms in the cell during tumor development from benign to malignant tumors. Current knowledge of the underlying molecular signal transduction pathways involved in tumorigenesis and metastasis within individual cells and their environment enables the identification of specific targets for experimental, diagnostic and therapeutic applications.

Examples described are : tyrosin kinase inhibitors, PET scan, nanobody theranostics, exosomes, radiotherapy/ vaccination and immune chackpoint inhibitors. Ultimately the challenge of therapy resistence will be tackled.

Date: 13 May 2015
Teacher: Marc Bracke

7. Medical imaging

Translational research is changing the practice of modern medicine and the way in which health problems are approached and solved. The use of small-animal models in basic and preclinical sciences is a major keystone for these kinds of research and development strategies, with small animal imaging representing an important bridge between discoveries at the molecular level and the clinical implementation in diagnostics and therapeutics. This lecture will elucidate how the focus in clinical imaging shifted from anatomical imaging to functional and molecular imaging, since the description of the human genome. The importance of small animal imaging, in this era of molecular imaging, will be highlighted.

The lecture will be followed by a visit to the INFINITY (INnovative Flemish IN vivo Imaging TechnologY) lab, the small animal imaging facility of Ghent University.

Date: 20 May 2015
Teacher: Christian Vanhove

8. Introduction into bio-informatics and computational biology

In the past decennium, the complete genome of hundreds of organisms has been sequenced and mapped. Already to date, the available data surpasses the capacity of specialised research teams and their computational resources.

Bio-informatics has emerged as a new field of research, aiming to enrich our knowledge of biology through application of know-how and techniques from informatics science on biological data. As such, bio-informatics contributes to a detailed insight in the functioning of living organisms. The field is largely dependent on tools and methods that guarantee an efficient storage, processing and interpretation of enormous amounts of biological data.

It is the goal of this session to familiarise students with the computational, system-biological and algorithmic aspects of the management, analysis and processing of biological data.

Date: 27 May 2015
Teacher: Wim Van Criekinge

9. Immunology

Immunology is the branch of biomedical science that deals with the response of an organism to exposure to microbial agents, e.g. potential pathogens (recognition of what is self and what is not). It deals with the defence mechanisms including all physical, chemical and biological properties of the organism that help it to combat its susceptibility to foreign organisms, material, etc.

This partim focusses upon how an infection leads to inflammation (first reaction), and a second line of defense or adaptive immune response. Also, it is demonstrated how pathogens strive to escaping from our immune system, and how this knowledge is translated in healthcare applications, like the development of vaccines. Basic knowledge will be provided to understand the consequences of a dysfunctional or failing immune system. In addition, methods and tools to study the immune system and immune response are described in detail. Finally, immune deficiency and related disorders are illustrated.

Date: 3 June 2015
Teachers: Filomeen Haerynck, Geert Leroux-Roels & Tom Taghon

10. Microbiology and the microbiome

The last lecture is devoted to microbiology, the broad spectrum of microscopic organisms (bacteria, viruses, fungi, parasites). The human body contains over 10 times more microbial cells than human cells, and they are understood to have an important impact on human health. The human microbiome has gained attention for its role in different diseases, like auto-immune diseases, diabetes, rheumatoid arthritis, multiple sclerosis, besides others. Specific attention is given to dysfunction of the intestinal microbiome in inflammatory bowel disease and treatment, and to tools and methods to study the microbiome.

Date: 17 June 2015
Teachers: Martine De Vos, Tom Van de Wiele & Mario Vaneechoutte

MORE INFORMATION & SUBSCRIPTION
www.ivpv.ugent.be/lifesciences

Fee

Payment after reception of the invoice. All invoices are due in thirty days.
All fees are exempt from VAT. Transfer and conversion costs are at the expense of the participant.

Single lesson	€ 150
Complete course	**€ 1.200**

Reduction

- When a participant of a company subscribes for the complete course, a reduction of 20% is given to all additional subscriptions from the same company, even on single sessions. Invoicing is done by one company invoice.
- AIG and VBIG members receive a reduction of 10% on the prices mentioned in the table.
- Special prices for Ghent University staff and members of Ghent University Association.
- Reductions can't be combined.

Cancellation policy

When cancelling up to 10 days before the start of the course 25% of the participation fee will be charged. When cancelling less than 10 days before the start of the course, the full fee is due.

Training cheques

Ghent University accepts payments by KMO-portefeuille (www.kmo-portefeuille.be; authorisation ID: DV.O103194).

Time

- The programme consists of different sessions. Each session can be followed separately.
- Plenary sessions are organised as follows:
  18h00 – 18h30: sandwich and drink
  18h30 – 20h00: part 1
  20h00 – 20h15: coffee break
  20h15 – 21h45: part 2
- Dates may change due to unforeseen reasons.

Location

- Most of the lectures are given in IVPV classroom, building 904, Technologiepark, Zwijnaarde.
- The 7th lesson will be given at Ghent University Hospital with a visit to the INFINITY lab.

Language

English is used in all presentations, exercises and documentation, so good knowledge of this language is necessary.

MORE INFORMATION & SUBSCRIPTION

www.ivpv.ugent.be/lifesciences

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