

ULLA Summer School 2024 – Sessions By Date

(This programme may be subject to change)

Monday 1 July 2024		
Course Title	Course Description	Name Teacher
<i>An Introduction to Nanomedicine: From Concepts to Therapies</i>	This course on Nanomedicine will provide an introduction to the use of nano-sized particles to be used for controlled drug delivery. The focus will be on polymer and lipid based drug delivery systems for the delivery of small molecules, peptides/proteins, and nucleic acids. Besides the characterization of these materials will be discussed.	Matthias Barz
<i>Computational Design and Synthesis of Small-molecule Modulators for Biological Targets</i>	Discover the power of computational techniques and retrosynthesis to design synthetically feasible small molecules. This 2-day course provides an entry-level and hands-on understanding of two crucial pillars of early drug discovery: How to harness computational techniques to design synthetically feasible small-molecule modulators for a biological target, and how to prepare meaningful amounts of that modulator for biological assays. Don't miss out on this unique opportunity to step into the shoes of a drug discovery expert and unleash your creativity in the world of drug innovation. Join us for two days of discovery, learning, and hands-on computational and retrosynthesis experience. <i>Pre-requisite: Basic organic chemistry knowledge</i>	Barbara Zarzycka Maikel Wijtmans
<i>A hands-on introduction into computational medicinal chemistry</i>	This entry-level course will give you hands-on experience with computational tools to dig deeper into the interactions between small molecule ligands and their protein targets. The integration of protein structures, ligand structures, and their bioactivities will provide you with a (structural) rationale for observed behavior.	Oscar van Linden Albert Kooistra

<p><i>Fundamentals of drug utilization research using real-world data</i></p>	<p>This course provides students with the skills needed to conduct drug utilization studies using real-world data. It covers selection of data sources, study design, and data management & analysis. Participants will explore various data sources and learn about linking data from different sources. Practical exercises with simulated datasets will teach study design principles and data management techniques. Real-world examples of multi-country studies will be discussed. Suitable for researchers, healthcare professionals, and students interested in pharmacoepidemiology and real-world data analysis.</p>	<p>Maurizio Sessa Björn Wettermark Morten Andersen Mohammadhossein Hajiebrahimi</p>
<p><i>Introduction to NMR spectroscopy in drug discovery</i></p>	<p>The course will give the fundamentals of high-resolution Nuclear Magnetic Resonance spectroscopy, furnishing the basis for interpretation of proton NMR spectra of organic molecules. The spectra of some natural compounds and drugs will be analyzed with the involvement of PhD students.</p> <p>After the explanation about the nuclear properties of the atoms, it will focus on the proton nucleus and on its behavior in a magnetic field. The vector model will be explained for understanding NMR experiments. During the course the following topics will be treated: the chemical shift, spin-spin coupling (geminal, vicinal, and long-range coupling), multiplicity of signals, coupling with equivalent and non-equivalent protons, behavior of protons on heteroatoms. An overview of bidimensional NMR techniques and of the use of NMR for the study of biomolecules and their interactions with a drug will be given.</p>	<p>Andrea Sartori</p>
<p><i>Getting off to a flying start for a great finish to your PhD</i></p>	<p>This course is targeted towards starting/early stage PhD students, to provide an opportunity to learn non-technical but critical concept that will help students to make the most of their PhD. The course instructors have graduated more than 200 PhD students collectively, and their wisdom on organisation, communication, publication, networking and conferences, and finalising the synopsis/defence will prove invaluable for students that attend this course.</p>	<p>Ben Boyd Thomas Rades Alex Bunker Karlis Berzins</p>
<p><i>Modern tools for pharmaceutical analysis – sample preparation and separation formats</i></p>	<p>The course will introduce the students to modern tools for pharmaceutical analysis with an emphasis on advanced liquid chromatographic techniques as well as methods exploiting the microfluidic format. These approaches offer new ways to perform bioanalytical procedures for pharmaceutically relevant problems.</p>	<p>Jörg Kutter Deirdre Cabooter</p>

<p><i>Inhalation route for local and systemic delivery of biological drugs</i></p>	<p>Biopharmaceuticals are going to dominate the pharmaceutical market in the future. However, their characteristics limited their administration to parenteral route in severe illnesses and hospital use. The application of safe and efficient alternative routes of delivery could open new opportunities and applications to these potent drugs.</p> <p>The airways epithelia have emerged as a safe and efficient absorption route for peptides and proteins and could represent the solution for non-invasive biopharmaceutical delivery. This short course will be divided in two parts: a general part about the difficulties related to drug delivery to the lungs, and a specific part about aspects related to the design, development, and characterization of biological drugs to be administered to the airways. In particular, pros and cons of selecting liquid or solid formulations and the matching of a suitable device for drug administration will be discussed. The course will address in particular the technological aspects related to drug delivery systems and platforms for this administration route considering also some specific applications such as vaccination. The course will also address, in interactive manner, some practical aspects related to the characterization the formulation for inhalation.</p>	<p>Annalisa Bianchera Ruggero Bettini</p>
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	Tuesday 2 July 2024	
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<i>Computational Design and Synthesis of Small-molecule Modulators for Biological Targets</i>	<p>Discover the power of computational techniques and retrosynthesis to design synthetically feasible small molecules.</p> <p>This 2-day course provides an entry-level and hands-on understanding of two crucial pillars of early drug discovery: How to harness computational techniques to design synthetically feasible small-molecule modulators for a biological target, and how to prepare meaningful amounts of that modulator for biological assays.</p> <p>Don't miss out on this unique opportunity to step into the shoes of a drug discovery expert and unleash your creativity in the world of drug innovation. Join us for two days of discovery, learning, and hands-on computational and retrosynthesis experience.</p> <p><i>Pre-requisite: Basic organic chemistry knowledge</i></p>	<p>Barbara Zarzycka</p> <p>Maikel Wijtmans</p>
<i>Fundamentals of drug utilization research using real-world data</i>	<p>This course provides students with the skills needed to conduct drug utilization studies using real-world data. It covers selection of data sources, study design, and data management & analysis. Participants will explore various data sources and learn about linking data from different sources. Practical exercises with simulated datasets will teach study design principles and data management techniques. Real-world examples of multi-country studies will be discussed. Suitable for researchers, healthcare professionals, and students interested in pharmacoepidemiology and real-world data analysis.</p>	<p>Maurizio Sessa</p> <p>Björn Wettermark</p> <p>Morten Andersen</p> <p>Mohammadhossein Hajiebrahimi</p>
<i>Metabolomics and Beyond</i>	<p>The Metabolomics and Beyond course covers state-of-the-art analytical approaches, with a strong focus on the fundamentals and recent instructive (clinical) applications</p>	<p>Rawi Ramautar</p> <p>Ahmed Ali</p> <p>Charlie Clark</p> <p>Nicolas Drouin</p> <p>Alida Kindt</p>

<p><i>From Idea to Innovation: Design Your Own Startup</i></p>	<p>This is a dynamic course for aspiring entrepreneurs interested in transforming concepts into successful ventures. Through a blend of theoretical frameworks and hands-on practical exercises, participants will delve into the fundamentals of startup ideation, market analysis, prototyping, and business model development. With a focus on fostering creativity, critical thinking, and effective problem-solving skills, students will learn how to validate ideas, mitigate risks, and harness innovation to create viable business opportunities. By the end of the course, participants will emerge equipped with the knowledge, tools, and confidence to embark on their entrepreneurial endeavors and navigate the challenges of the startup landscape.</p>	<p>Willem Jaspers</p>
<p><i>New pharmacological strategies in cardiovascular prevention: small molecules and biotechnological approaches</i></p>	<p>The proposed course aims to provide knowledge on the latest findings on hypercholesterolemia and cardiovascular risk. We will discuss in an interactive manner aspects related to the recent guidelines for cardiovascular prevention and review the newly developed drugs for cardiovascular diseases.</p>	<p>Francesca Zimetti Bianca Papotti</p>
<p><i>Size matters: Advanced characterisation and concepts in colloidal drug delivery</i></p>	<p>Colloids have had a profound impact on human society in the last few years. For example, the LNP-based Covid-19 vaccines are colloidal particles, requiring a controlled size in the colloidal range for their interaction with biology. Although only relatively recently hitting the headlines, they have been in development for over 40 years, with decades of colloid science underpinning their development. Indeed, colloid science has an impact across all facets of drug delivery. Of course, colloids and colloidal structure is not only about particles – it captures issues where structure and interfaces are important to function, often not achievable with the bulk material from which they are prepared. Understanding the challenges with different types of colloidal materials, their structure and composition, how they interact with the body and how they can be translated into medicines are all important topics for the contemporary pharmaceutical scientist to be exposed to. To this end, this course will give a contemporary view of challenges and opportunities across colloidal systems in drug delivery, where you will hear the latest thinking and developments across the materials, their biointeractions, analytical methods to study composition and structure and the production of colloid-based medicines.</p>	<p>Ben Boyd Anette Mullertz</p>

<p><i>Ex vivo ocular models for drug delivery studies</i></p>	<p>The topic of the course concerns the development, validation and application of ex-vivo ocular models for the evaluation of both conventional and innovative formulations for drug delivery to the anterior and posterior segment of the eye.</p>	<p>Sara Nicoli</p>
<p><i>Model-informed clinical drug development (MIDD): from big data to digital twins</i></p>	<p>Model-informed drug development (MIDD) has evolved as a quantitative approach in drug development and is now widely applied in clinical pharmacology as a tool to integrate knowledge and improve decision making. Main applications include experimental protocol optimisation, extrapolation, dose selection, and algorithms for personalised or individualised interventions.</p>	<p>Oscar Della Pasqua Alessandro di Deo Salvatore D'Agate</p>
<p><i>Advanced DNA manipulation: 101 ways to skin that (cloning) cat.</i></p>	<p>DNA assembly, or cloning, is a core technology in molecular biology and central to many biological projects. Many researchers still use 50-year-old tools in their cloning in what remains a common major bottleneck for students. The course is focuses on giving the student more options whether they are cloning one gene, assembling a circuit or creating a library. The course will start from basic cloning and discuss some of the methods developed in the last 20 years, including some less orthodox ones. The course also introduces the students to Benchling, a cloud-based molecular biology suite and electronic lab book.</p>	<p>Vitor Pinheiro</p>
<p><i>Quality by Design (QbD) in Drug Development</i></p>	<p>Learn about the science behind Quality by Design (QbD) based product design! This course will walk through the key elements of QbD in one day and you are ready to face the real-life challenges in the drug development process.</p>	<p>Jukka Rantanen Anette Mullertz</p>

	Thursday 4 July 2024	
Course Title	Course Description	Name Teacher
<i>Discovery and structural characterization of novel peptides - application of mass spectrometry, transcriptome mining, and NMR</i>	The course will concentrate on the methods used for the discovery of cysteine-rich polypeptides from plants and animals as novel biopharmaceuticals or for molecular engineering. Through the course, attendees will learn about MS/MS peptide sequencing combined with transcriptome mining in elucidating the amino acid sequence and cysteine pattern. Additionally, the course will give a basic overview of NMR experiments used in peptide structure determination. The course will comprise an introductory, theoretical part as well as practical work on real data.	Blazej Slazak Sunithi Gunasekera
<i>Viral vectors and gene therapy: turning infectious viruses into efficient vehicles to halt and cure genetic disorders.</i>	Gene therapy has become a transformative reality in healthcare, offering a promising solution for inherited, previously incurable disorders. In this lecture, we delve into the technological advancements driving the gene therapy revolution, explore pivotal discoveries, discuss critical challenges in manufacturing, biosafety, and ethics.	Rik Gijbbers
<i>Improved solubility by drug nanocrystals, cocrystals and coamorphous systems</i>	Poor solubility is one of the major problems in the drug industry, and many techniques to improve solubility/dissolution properties exist. Supersaturation is one approach to increase the solubility and in this course concept of supersaturation as well as supersaturation based techniques to improve the solubility, e.g. particle size decreasing, amorphous systems and cocrystallization approach are studied in detail.	Leena Peltonen
<i>Development, characterisation and regulation of information medicines</i>	This course will walk you through the revolutionary technologies behind the information medicines (such as lipid nanoparticle-based mRNA vaccines), gaining insights into their development processes and mechanisms responsible for their action. The course offers insights into the scientific principles and regulatory framework, with some practical examples for better understanding of formulation strategies and characterization of these innovative nanomedicines, representing the frontier of healthcare. For optimal comprehension and active participation in the course, it is advisable to possess a foundational understanding of nanomedicines and colloidal stability in general.	Gerrit Borchard Ines Nikolic

<i>Intro Science Teaching</i>	An essential responsibility for PhD students is sharing knowledge and expertise through teaching and supervision responsibilities. But what is the best way to tutor students? This course will allow you to practice your teaching skills in mini-lessons, gain useful information and feedback, and reflect critically on your role in higher education through group and whole-class discussions.	Jacqueline van Muijlwijk-Koezen Isabel Braadbaart
<i>Modern medicinal chemistry</i>	In this course we will go over the basic concepts of medicinal chemistry and build upon them with modern approaches. All three aspects of medicinal chemistry, i.e. organic chemistry, computation chemistry and molecular pharmacology will be covered. Themes that will be touched upon will be allosterism, binding kinetics and covalent binding. The course will consist of (interactive) lectures and a workshop.	Daan van der Es Laura Heitman
<i>Barriers of the CNS and their Impact on Brain Drug Disposition</i>	Join our comprehensive course on CNS drug discovery and delivery. Explore topics including brain barrier transport mechanisms, the free drug theory, and innovative methodologies for brain drug delivery assessment. Through lectures and case studies, enhance your understanding and strategic decision-making skills in CNS therapeutics. Unlock the secrets to revolutionize CNS drug development with us!	Irena Loryan Elizabeth de Lange Frida Ballgren
<i>Workshop on Protein Structure Exploration in Drug Design and Discovery for Non-Computational Scientists</i>	This hands-on workshop will employ molecular modelling tools to explore structural data resources to understand protein structure and function. The main aim is to interpret and exploit biomolecular structures, focusing on how best to use structural information to gain the most from it in specific research contexts.	Shozeb Haider Francesco Gervasio
<i>Global Mental Health</i>	This course is designed to provide ULLA students with greater understanding of the global mental health crisis. We will focus on discussing and understanding the most prevalent mental health disorders, and culturally sensitive approaches to mental health care. This day course will be a mix of taught components and group discussions.	Ruth Brauer Oksane Pyzik
<i>Genetic code reprogramming</i>	The standard genetic code allows for production of highly complex and diversely functional proteins through the use of 20 canonical amino acids. Approaches have been developed to expand this with the at-will introduction of one or more non-canonical amino acids by introduction of acylated tRNA,	Seino Jongkees Ivana Drienovksa

	<p>re-assigning one or more of these codons. In this way new functionality can be introduced into peptides and proteins, such as labeling/conjugation, post-translational modifications and analogues, catalysis, (photo)uncaging, drug-likeness, pharmacophores, fluorophores, and more, dramatically expanding the possibilities for study of protein function and application of proteins/peptides in biological and industrial settings.</p> <p>In this course we will cover both <i>in vitro</i> and <i>in vivo</i> genetic code reprogramming, including the theoretical basis for 'standard' translation and acylation of tRNA, expanding this with orthogonal acylation systems, methods for reducing competition with natural tRNA or release factors, choosing suitable amino acids, and example applications from the literature.</p>	
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	Friday 5 July 2024	
Course Title	Course Description	Name Teacher
<i>Prefomulation: pharmaceutical and biopharmaceutical profiling</i>	<p>Preformulation is the study of physicochemical, mechanical and biopharmaceutical properties of a drug substance that can influence the design, development, manufacture and (bio)performance of a drug product. It is an essential step in the pharmaceutical development of an API. It is the process by which candidate drugs are characterized with respect to the appropriateness to be formulated and processed to a useful dosage form. During this phase of the development, information about the physicochemical properties (e.g., solubility, ionization behavior, solid state properties,...), biopharmaceutical properties (e.g., permeability through bio-membranes) and stability profile (physical, chemical, compatibility with excipients, etc.) of the drug candidate is collected. This information guides the formulation scientist as it will dictate many of the possible formulation and processing approaches.</p> <p>In this course, fundamental physicochemical and biopharmaceutical concepts are discussed including solubility and dissolution rate, ionization behavior, partitioning, solid state properties (polymorphism, amorphous and crystalline state), salts and salt selection, physical and chemical stability, powder properties and drug absorption profiling. Analytical techniques to assess solid state properties such as X-ray diffraction, differential scanning calorimetry, dynamic vapor sorption, thermogravimetric analysis, infrared and Raman spectroscopy are briefly discussed and illustrated with examples.</p>	Guy van den Mooter
<i>Advances in the study of medicinal plants: analytical methods and pre-clinical testing for chemical complexity</i>	<p>This course is focused on the fascinating complexity of medicinal plants. Supported by modern analytical and experimental techniques and by a marked interdisciplinary approach, the study of medicinal plants currently is very topical for the scientific community, thus the aim of this course is to provide a brief insight of the modern research on herbal products through a program that includes normative aspects, ethnobotany for drug discovery, in vitro and in silico advanced testing and, finally, examples of peculiar mechanism and clinical uses of herbal products.</p>	Marco Biagi
<i>Structural modelling of proteins, peptides, and their complexes: Computational</i>	<p>Protein-protein interactions (PPIs) play crucial roles in many biological processes and have become major targets for the discovery of new drugs. Among them, peptide derivatives are very promising therapeutic agents with appropriate size, specificity, and bioavailability for targeting PPIs. On the</p>	Tập Ha-Duong Liuba Mazzanti

<i>biophysics and artificial intelligence approaches</i>	<p>route of peptide drug design, a key step is the determination of the three-dimensional structures of the protein-protein targets and the protein-peptide complexes.</p> <p>The proposed course aims at providing an overview of both the artificial intelligence (3h) and the computational biophysics (3h) approaches and techniques that are used for predicting the protein structures and protein-protein interactions, as well as for guiding the structure-based development of therapeutic peptides. In particular, the strengths, weaknesses, and complementarity of these two approaches will be discussed.</p>	
<i>Formulation of therapeutic proteins</i>	<p>Proteins are an increasingly important class of drug molecules to treat various, often serious, diseases. Their structural complexity, administration and formulation differs markedly from those of most conventional small drug molecules, and therefore require a different approach to formulation development. In this course we will discuss protein chemical and physical instability, how to stabilize proteins in a formulation, how to properly characterize protein integrity in the formulation, and finally discuss one special side effect of protein drugs, immunogenicity, and its relation to formulation.</p>	<p>Marco van de Weert Vito Foderà</p>
<i>Extracellular Vesicles (EVs) in health and disease</i>	<p>This course gives a general introduction to extracellular vesicles, their handling procedures (guidelines, isolation from in vitro and in vivo sources, purification and characterization), and applications.</p>	<p>Marjo Yliperttula Riina Harjumäki</p>
<i>Post-marketing research into the safety of drugs using big data and target trial emulation.</i>	<p>This day course is designed for students who are interested in pharmacoepidemiology or Phase 4 trial research. We would like to share with our ULLA summer school students how we conduct cohort and target trial emulation studies, to assess the use and safety of commonly used drugs.</p>	<p>Li Wei Ruth Brauer</p>
<i>Emerging concepts of GPCR structure and function</i>	<p>Dysregulation of G protein-coupled receptors (GPCRs) signalling underlies many diseases and therefore, GPCRs are the target of choice for today's therapeutics. GPCRs homo- and heteromerize and can signal via multiple pathways, resulting in differential spatial and temporal signaling profiles. Recent advances in GPCR structural and chemical biology provide invaluable structural information including complexing of canonical effector proteins. Also, GPCR function can be modulated by multiple agents (small molecules, biologicals). In addition, GPCRs appear to be secreted into extracellular vesicles (EVs), known to contribute to intercellular communication. In this course we focus on the emerging concepts of GPCR structure and function, as these provide important insight</p>	<p>Martine Smit Chris Schafer Marco Siderius Raimond Heukers Reggie Bosma</p>

	and new means to effectively target GPCRs. We will present and address the following topics: biophysical approaches (smFRET, crystallisation, Cryo-EM), differential signaling (e.g. classical vs atypical, endosomal), convergence with EVs biology and targeting with biologicals.	
<i>Basic concepts in medicinal chemistry</i>	<p>This course is designed for students with an interest in life sciences and the biotech/pharmaceutical industry but without prior education in this field. A general introduction will be given to the process of drug discovery, drug design and synthesis, drug development and drug safety assessment.</p> <p>Subsequently, potential drug targets, mechanisms of drug actions (including drug-receptor/enzyme) Using various drug classes, relationships between chemical structures and biological activities will be derived and illustrated. Finally, various modern developments and tools will be illustrated by recent applications in the field of drug research, medicinal chemistry and toxicology.</p>	Iwan de Esch
<i>How to reduce the incidence of cancer in kidney transplant patients?</i>	Kidney transplant recipients need long term treatment with immunosuppressive drugs, to prevent rejection of the transplanted organ. As a result of this treatment the risk of developing cancer is increased. In this course we will identify the drugs with which patients are treated and the types of cancer of which the incidence is most increased. Furthermore, in groups we will design studies with the aim to reduce the incidence of cancer.	Teun van Gelder
<i>Programming with R</i>	<p>This general course focusses on programming in R. No prior experience with R or programming is expected.</p> <p>Learning goals: After following this course you will be able to use R for data manipulation and visualization. You will be able to reformat data as needed, calculate summary statistics and to visualize results in publication ready graphs. Moreover, you will learn the basic structure of the language.</p> <p>The course will contain a part plenary instructions, but mostly consist of programming along with the lecture materials. Although we will have practice data available, it is also possible to bring your own data to directly apply what you learned to those data.</p>	Laura Zwep