# 课程大纲
# COURSE SYLLABUS

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| **1.** | **课程代码/名称**<br>**Course Code/Title** | 类器官与生物医学研究<br>Organoids in Biomedical Research |
| **2.** | **课程性质**<br>**Compulsory/Elective** | 选修 |
| **3.** | **开课单位**<br>**Offering Dept.** | 医学院 药理学系 |
| **4.** | **课程学分/学时**<br>**Course Credit/Hours** | 3/48 |
| **5.** | **授课语言**<br>**Teaching Language** | 英文 |
| **6.** | **授课教师**<br>**Instructor(s)** | 李亮 |
| **7.** | **开课学期**<br>**Semester** | 秋季 |
| **8.** | **是否面向本科生开放**<br>**Open to undergraduates or not** | 否 |
| **9.** | **先修要求**<br>**Pre-requisites** | （如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）<br><br>无 |

**10. 教学目标**
**Course Objectives**

（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）
本课程将介绍类器官等新型模型的基本特性、构建方法、应用原则，及其在生物医药科研与药物研发中的应用案例解读。类器官等新型生物医药模型在新冠疫情以来备受瞩目，也在近年来的生物医药研发中进展日新月异，起到越来越不可忽视的作用。对于这一前沿方向，本课程将提供基本的知识与应用、评价原则介绍，结合实际案例让医学、生命科学、药学、生物医学工程等学科的学生了解相关基础知识和学科发展。同时，生物医药研发中类器官等模型的应用是一个关键要素，本课程可为学生的未来科研、工业界职业发展提供良好的助力，也为研究生的科研项目提供新的工具和研究对象，加深学生对于生理学、病理学、药学等学科的深入理解。

**11. 教学方法**
**Teaching Methods**

（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

本课程以课堂教学为主来介绍学科基本知识解读，同时提供实际应用场景探讨以让学生对相关模型的应用前景具备认知。课程也将针对学科的前沿发展提出相关问题，让学生进行以问题为中心的文献挖掘与小论文总结，从而在应用本课程所涉基本理论解决问题的过程中加深其对课程内容的理解。

**12. 教学内容**
**Course Contents**
（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）

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| **Section 1** | Introduction: Cells, Animals, Clinical Samples, and Mini-Organs<br>● Overview of the commonly used and novel models in biomedical research and therapy development |

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| | ● Introduce the individual characteristics of the different categories of biomedical models<br>● Introduce the specific application scenarios of each type of the models<br>● Compare the pros and cons of each category of the biomedical models<br>● Organoids as a rising star in biomedical models<br>● In-class discussion: When we talk about research models, what are the main aspects to consider? |
| **Section 2** | Basic Principles of Organoids Construction<br>● Overview of organoids: definition, history, and applications<br>● Introduction to stem cell biology related to organoids construction<br>● How to construct organoids, and what they can be used for – an overview<br>● Common problems encountered in organoids construction<br>● In-class discussion: What is the difference between organoids and other biomedical research models? What are the unique characteristics of organoids, which cannot be replaced by other models? |
| **Section 3** | Development of organoids technology and the theory behind<br>● Why organoids were developed for biomedical research<br>● Early-stage research on organoids development<br>● Organoids and developmental biology<br>● Main stages of the progress of organoids technology<br>● Importance of organoids during COVID-19 pandemic for biomedical research and therapy development<br>● In-class discussion: How developmental biology promoted the technical advance of organoids construction? What may be the future promoting factors for organoids technology? |
| **Section 4** | Gut Organoids: Stomach, Intestine, and Colon<br>● Anatomy and physiology of the major sections of the gut: stomach, intestine, and colon<br>● How to construct gut organoids, and what have been achieved so far<br>● Key mechanisms involved in gut organoids differentiation<br>● Application of gut organoids in biomedical research, with a focus on the recent COVID-19 research<br>● Gut organoids and gut microbiota<br>● In-class discussion: What key features must be there for successful gut organoids? What are the requirements for the experimental set-up to mimic a real gut micro-environment? |
| **Section 5** | Respiratory Organoids: Upper Airway and Lower Airway<br>● Anatomy and physiology of the major sections of the respiratory system: upper airway and lower airway<br>● How to construct respiratory organoids, and what have been achieved so far<br>● Key mechanisms involved in respiratory organoids differentiation<br>● Commonly used experimental set-up for respiratory organoids<br>● Application of respiratory organoids in biomedical research, with a focus on the recent COVID-19 research<br>● In-class discussion: Similarity and difference between gut and respiratory organoids, from main features to culture conditions. |
| **Section 6** | Brain Organoids and Blood Vessel Organoids<br>● Difficulties encountered in the development of brain organoids: technological and ethical |

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| | ● Key mechanisms involved in brain organoids construction<br>● Application of brain organoids in biomedical research<br>● Difficulties encountered in the development of blood vessel organoids<br>● Key mechanisms involved in blood vessel organoids construction<br>● Application of blood vessel organoids in biomedical research<br>● In-class discussion: Influence of cell sources on organoids construction |
| **Section 7** | Introduction to the Research Literature of Organoids<br>● Summary of a selected literature pool of organoids development and research applications<br>● How to read the literature – experience with organoids literature<br>● Class discussion on the organoids literature and topic selection for individual literature analysis report of the students |
| **Section 8** | Liver Organoids and Kidney Organoids<br>● Anatomy and physiology of liver and kidney<br>● Key mechanisms involved in liver organoids construction<br>● Progress of liver organoids development using different methods<br>● Key mechanisms involved in kidney organoids construction<br>● Application of liver and kidney organoids in biomedical research, with a focus on the recent COVID-19 research<br>● In-class discussion: What is a good representation of the target organs when the organ itself is complicated? |
| **Section 9** | Tumour Organoids<br>● Introduction of the various categories of tumour organoids in research and biomedical industry<br>● Application of tumour organoids in cancer research and treatment<br>● Tumour organoids and precision medicine<br>● 2-D, 3-D, spherical and other shapes: how would the geometry affect the application of the organoids?<br>● Drug sensitivity assays using tumour organoids for precision medicine<br>● In-class discussion: What aspects of tumour biology can benefit from organoids technology? |
| **Section 10** | Application of Organoids in Drug Development<br>● Introduction to the pipeline of drug development<br>● Organoids as a drug screening platform<br>● Organoids and Phase I clinical trial<br>● Organoids and Phase II clinical trial<br>● Organoids and precision medicine<br>● Limitations of current technologies in organoids construction and application<br>● Class discussion and project assignment: application of organoids in postgraduate biomedical research project |
| **Section 11** | Organoids on a Chip and Others – Innovations with Engineering<br>● Why engineering innovations are needed for organoids development<br>● Tissue, immune cells, and microbiota, the missing links in organoids construction<br>● Tissue engineering and organoids construction<br>● Microfluid chips, 3-D printing, and hydrogels for organoids construction<br>● Organoids on a chip<br>● Combining organoids of different sources and with other models |
| **Section 12** | Application of Organoids in a Biomedical Research Project |

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| | | ● Application of organoids in a research project – when, what, and how<br>● Typical scenarios of organoids application in a biomedical research project<br>● Basic requirements of organoids platform set-up in a biomedical lab<br>● Experience with organoids application in biomedical research projects<br>● Brain storm of organoids application in a biomedical lab scenario<br>● In-class discussion on the essay writing plans |
| | **Section 13** | Organoids and Other Models Part I<br>● Comparison of organoids and primary cells<br>● Comparison of organoids and clinical samples<br>● Application of organoids and cell-based models in biomedical research and drug development<br>● Combining organoids with primary cells<br>● Organ-on-a-chip and Lab-on-a-chip: the future?<br>● In-class discussion: The next generation of cell culture |
| | **Section 14** | Organoids and Other Models Part II<br>● Comparison of organoids and animal models<br>● Introduction of animal models for various research areas<br>● Organoids vs. humanized mouse model: different application scenarios<br>● Tumour organoids and patient-derived xenograft animal models<br>● Combining organoids with animal models<br>● In-class discussion: From organoids culture to organ transplant – what are the remaining steps |
| | **Section 15** | Organoids and Other Models Part III<br>● Introduction of other biomedical models<br>● Comparison of organoids with other biomedical models<br>● Combing the strengths of organoids with other biomedical models<br>● Organoids for animals<br>● Innovations for organoids: science and engineering<br>● In-class discussion: how shall we construct a "perfect" biomedical model by combing organoids and other biomedical models |
| | **Section 16** | Summary of the course, future directions of organoids technology, and feedback<br>● Course summary: concepts, classifications, and main theory<br>● Course summary: criteria of successful organoids for different types of organs<br>● Course summary: applications of organoids in biomedical research and drug development<br>● Course summary: limitations in current organoids development<br>● Discuss on the future directions of organoids technology<br>● Feedback on the course content |
| **13.** | **课程考核**<br>**Course Assessment** | |
| | （①考核形式 Form of examination；②.分数构成 grading policy；③如面向本科生开放，请注明区分内容。If the course is open to undergraduates, please indicate the difference.）<br><br>考核形式：考查<br>分数构成：课堂表现 10%，小论文 30%，文献分析报告 30%，课堂测验 30%（共一次）。 | |

| 14. | 教材及其它参考资料<br>**Textbook and Supplementary Readings** |
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| | ● Organoids and Mini-Organs, ed.1 by Jamie Davies; Melanie Lawrence; ISBN: 9780128126363; Academic Press, 2018<br>● Organoids: Stem Cells, Structure, and Function, ed.1 by Kursad Turksen; ISBN: 9781493976171; Humana Press, 2019 |