Introduction Prof. Altug

Module 1: Laboratory of Biomedical Microfluidics: antibody discovery

Module 2: Laboratory of Virology and Structural Immunology

Module 3: Bio-Nano-Photonic Systems Laboratory

Hatice Altug
06.11.2024

Wed 8h15-10h00 (Default time unless otherwise noted) / classroom: INM 203

Schedule and course organization

BIO 467 Fall 2024

#	DATE		TOPIC	WHO
1	Sept	11	General Introduction **(all students join)**	**Aleks Antanasijevic**
2	Sept	18	Librarian lecture on scientific literature search Intro Module 1 (**all students join starting at 10:00 am-Christoph)**	**EPFL Library Team**
			Module 1	
3	Sep	25	Groups ABC DEF will be assigned on Monday of the week Prep Module 1 (TA's available in classroom)	**Christoph Merten**
4	Oct	02	Module 1 group **ABC** only	
5	Oct	09	Module 1 group **DEF** only Introduce Module 2 (**all students join starting at 10am-Aleks**)	
			Module 2	
6	Oct	16	Prep Module 2 (TA's available in classroom)	**Aleks Antanasijevic**
	Oct	23	**Holidays!**	
7	Oct	30	Module 2 group **DEF** only	
8	Nov	6	Module 2 group **ABC** only Intro Module 3 and Intro individual topics (**all students join starting at 10am-Hatice**)	
			Module 3	
9	Nov	13	Prep Module 3 (TA's available in classroom)	**Hatice Altug**
10	Nov	20	Module 3 group **ABC** only	
11	Nov	27	Module 3 group **DEF** only	
			Individual efforts	
12	Dec	4	Preparation for individual report and presentation	**ALL**
13	Dec	11	Preparation for individual report and presentation	
14	Dec	18	Hand in reports (due 23:59 Dec 17th); **8.15am - noon** Individual presentations (**all students**)	

Teaching Assistants

jiayi.tan@epfl.ch

berkay.dagli@epfl.ch

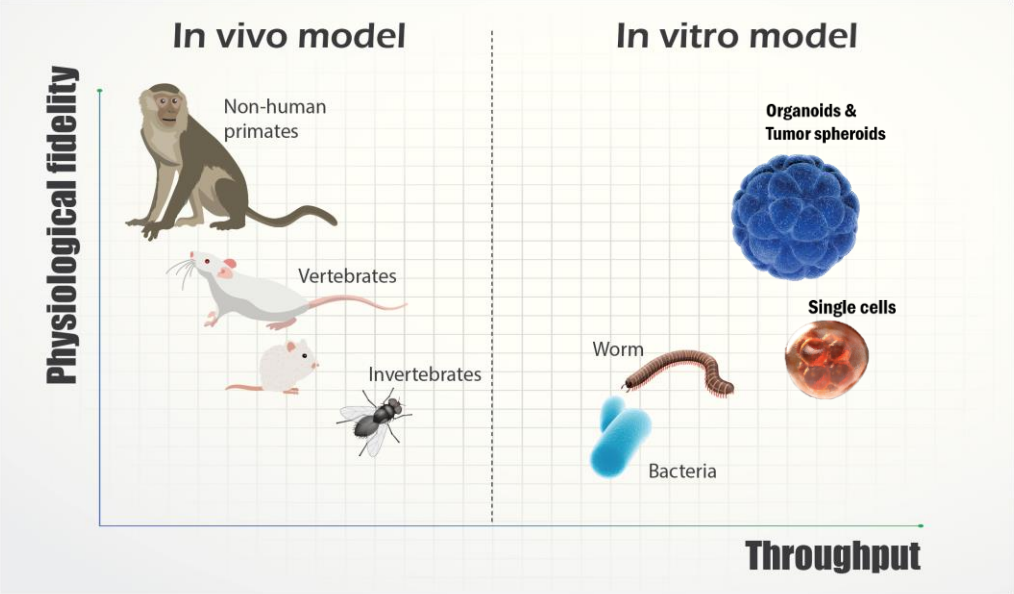
Contact person for: *Groups A, D & C* *Group B, E & F*

- Jiayi and Berkay will be able to provide in-person support on November 13th in the classroom.
- You can also contact them by email to clarify things.
- Please send them your questions ahead, so that they can prepare for it.

Technologies for Organoids & Organoids-on-Chip

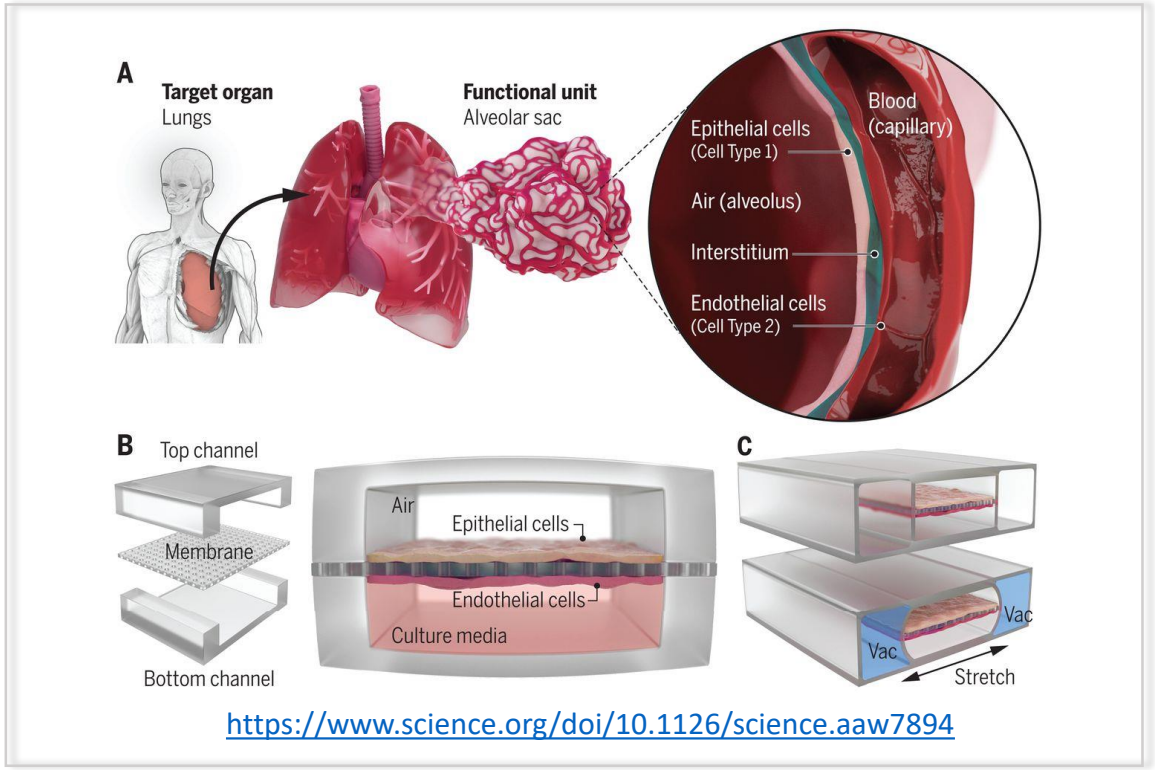
Organoids: 3D in-vitro models

- Recapitulates physiology and pathophysiology



Organoids-on-chip: microfluidic devices containing organoids from living cells grown/controlled in fluid flow

- Customizable by micro-engineering & lithography techniques
- Provides control e.g. dynamic flow conditions, mechanical stimulations, chemical concentrations and gradients…
- Can improve reproducibility
- Compatible with scaling & high throughput analysis

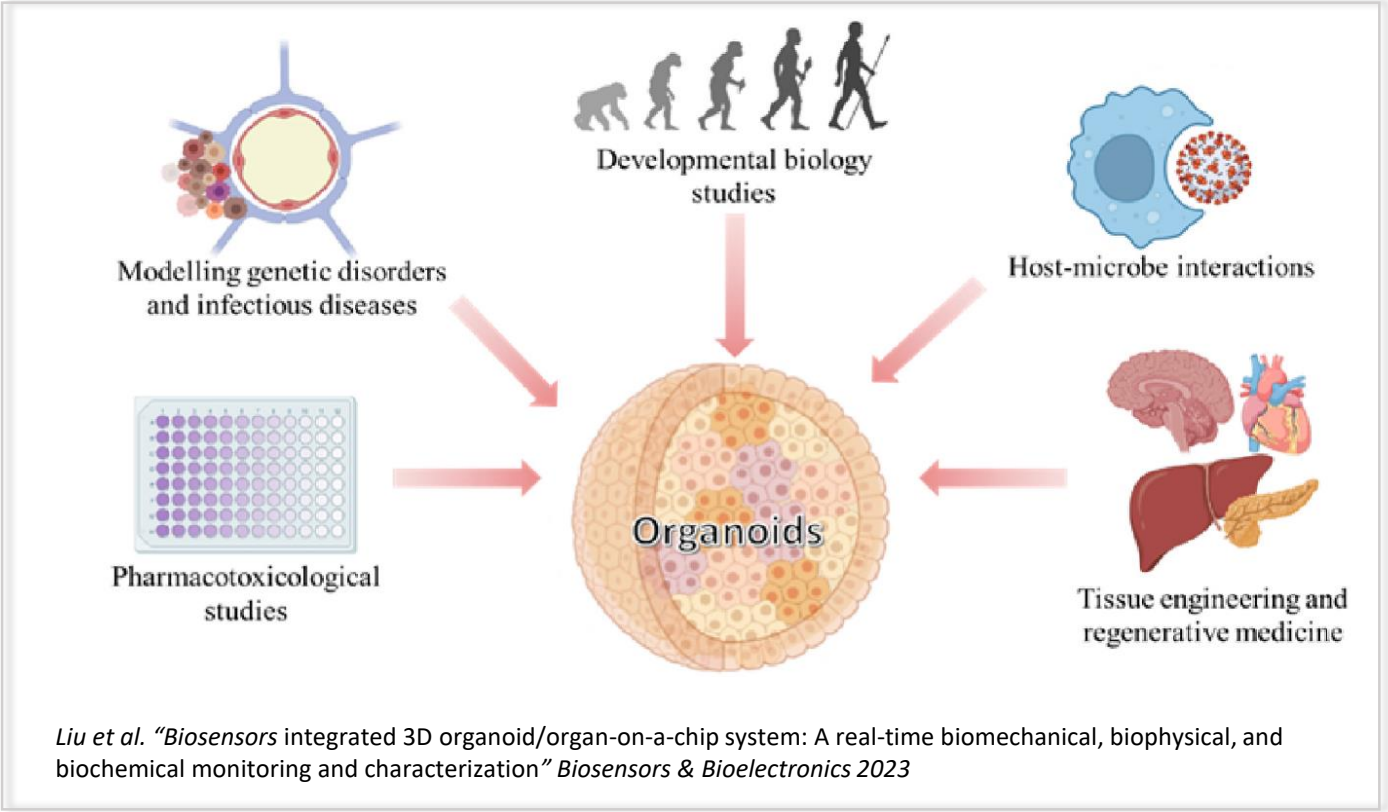


https://www.science.org/doi/10.1126/science.aaw7894

Organoids & Organoids-on-Chip Technologies

Emerging tool for:

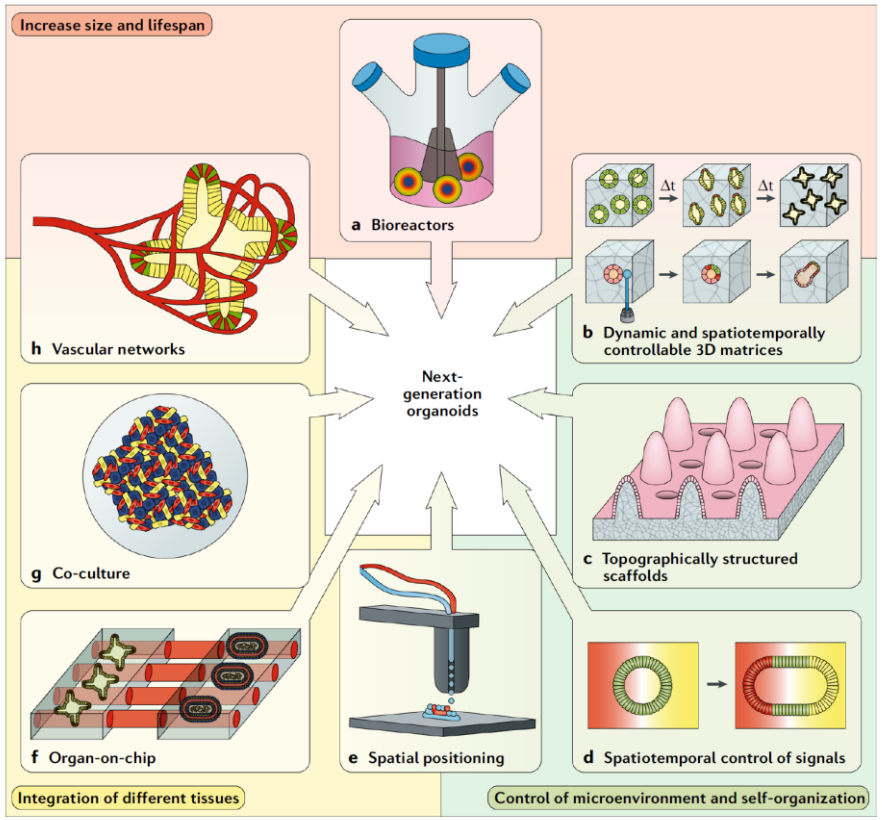
- Basic research (e.g. disease modelling, development biology)
- Regenerative medicine & tissue engineering
- Drug screening
- Personalized treatment (e.g. cell therapy)



Liu et al. "Biosensors integrated 3D organoid/organ-on-a-chip system: A real-time biomechanical, biophysical, and biochemical monitoring and characterization*" Biosensors & Bioelectronics 2023*

How to derive & form organoids and organoids-on-chip?

- Approaches and techniques vary significantly: matrigel, suspension culture, microfluidics are among the existing methods …
- During organoid formation, it is critical to provide necessary input & microenvironment
- Overall, it is desired to control size & lifespan, microenvironment & self-organization, integrate different types of tissues and have dynamic/adaptable systems → new biomaterials and lab-on-a-chip systems are important to leverage

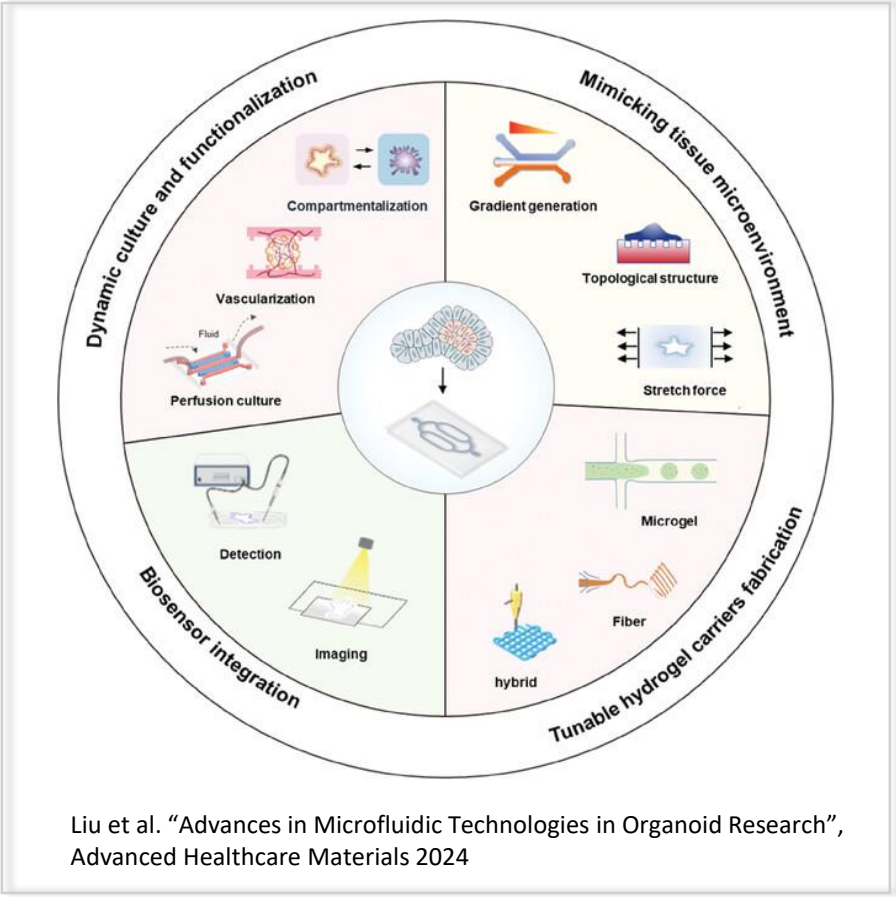


Rossi et al. "Progress and Potential in Organoid Research"*, Nature Reviews 2018*

How to characterize organoids & organoids-on-chip?

- **We need to verify that formed organoids and organoids-on-chip have biological & physiological fidelity**

- During organoid formation it is important to monitor essential indicators (e.g. vascularization..)
- Integrate (*in-line)* characterization techniques such as biosensors and imaging tools to measure (*ideally in a temporally and spatially resolved manner*) critical physical, mechanical or biochemical responses

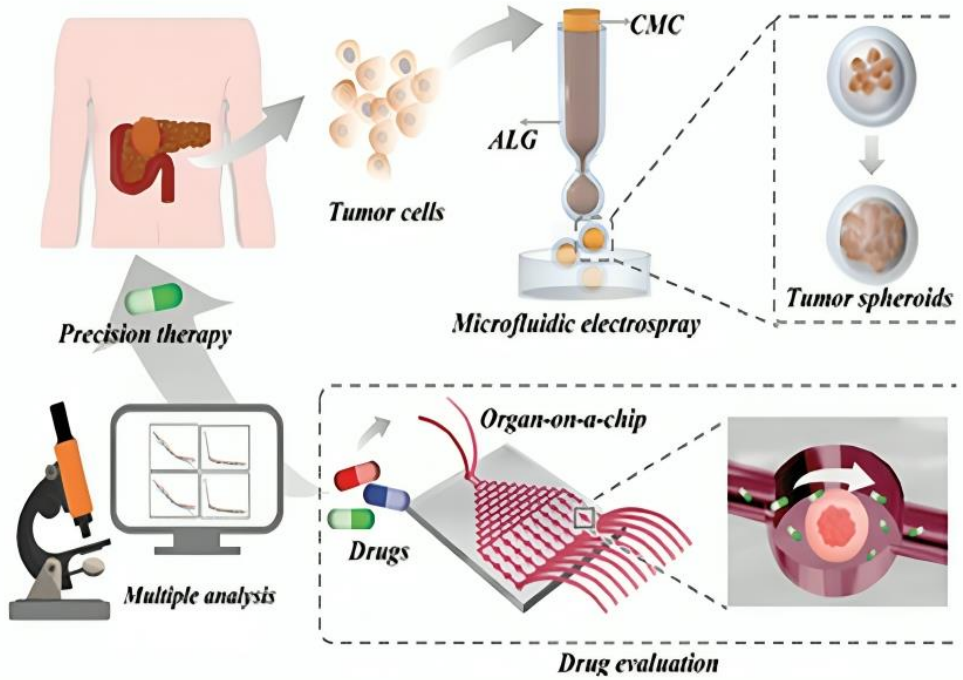


Liu et al. “Advances in Microfluidic Technologies in Organoid Research”, Advanced Healthcare Materials 2024

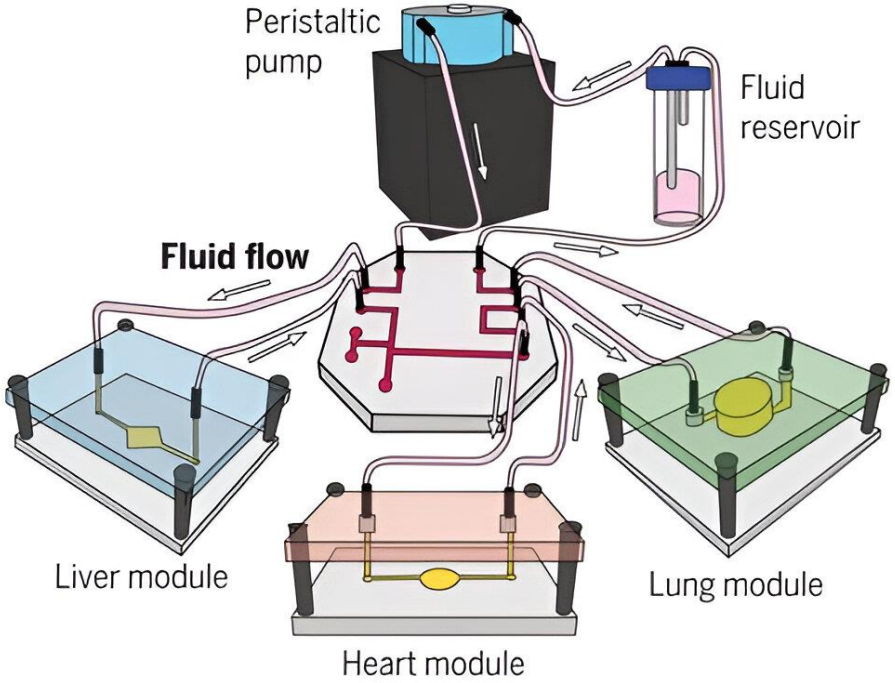
Application opportunities for organoids & organoids-on-chip

- Perform functional studies: Study various indicators in response to different applied stimuli (e.g. drug administration)
- Integrate different complementary sensors and imaging tools to analyze a broad panel of indicators/responses
- Integrate multiple organs on chip (towards body-on-chip..)→ study interactions at a higher level of biological relevance

Examples:



Liu et al. "Advances in Microfluidic Technologies in Organoid Research", Advanced Healthcare Materials 2024



Park et al. "Organoids-on-a-chip", Science 2019

Module 3 papers

Group A & D

Formation of organoids and organoids-on-chip

Quintard et al. "A microfluidic platform integrating functional vascularized organoids-on-chip*", Nature Communications 2024*

Group B & E

Functional analysis and characterization of formed organoids and organoids-on-chip

Lorenzo-Martin et al. "Patient-derived mini-colons enable long-term modeling of tumor–microenvironment complexity", Nature Biotechnology 2024

Group C & F

Body-on-Chip: Integration of multiple components & interaction analysis

Zhang et al. "*Multisensor-integrated organs-on-chips platform for automated and continual in situ monitoring of organoid behaviors*", PNAS 2017

Reviews for general introduction and background information:

- *Park et al. "Organoids-on-a-chip", Science 2019.*
- *Liu et al. "*Advances in Microfluidic Technologies in Organoid Research"*, Advanced Healthcare Materials 2024*
- *Liu et al. "Biosensors* integrated 3D organoid/organ-on-a-chip system: A real-time biomechanical, biophysical, and biochemical monitoring and characterization*" Biosensors & Bioelectronics 2023*
- *Rossi et al. "*Progress and Potential in Organoid Research"*, Nature Reviews 2018*

- In your presentation, analyze i) **how the paper** assigned to your group (e.g. **approached/technologies that are** described in the paper) **stands in the field**, ii) **point out its strengths** & **weaknesses** and iii) **give your suggestions for future improvements & your outlook for its next steps**.
- We suggest reading review papers to get an overview of **the field**. Listed ones could be a good starting point.

BIO-467 groups 2024

Group A
Benjamin Charles Aouzir
Justine Bataillard
Tistou Émile Luisiere
Camille Anne-Marie Claudine Pittet

Group B
Alice Canuti
Berta Céspedes Sarrias
Camille Hilde Rosine Begon
Melissa Alexandra Dubugnon

Group C
Sandra Adel Aziz Gebraiel
Albane Irène Marie Madeleine Knoche
Lou-Anne Suzanne Lamouroux
Ghali Laraki

Group D
Amélie Camilla Maloberti
Timothy Mann
Sarra Chaabane
Abderrahmane Ould Bay

Group E
Emi Myzeqari
Clarisse Jeanne Maylis Pierre
Niko Maximilien Pindao
Aygul Bayramova

Group F
Maé Rollin
Valentino Antonio Vaccaro
Margot Yvette Nicole Vogelsperger
Ruike Yan

Module 3 Presentation Schedule

Preparation day: Please contact TA's for appointments (e.g., meet on November 13th during the lecture time)

Presentations of groups A,B & C: November 20th, 8.15-10am

Presentations of groups D,E & F: November 27th, 8.15-10am