

Microfluidic Horizons 2026

Exploring Frontiers in Physical
Chemical & Biomedical Sciences

Pre-Conference Short Courses

May 16 - 17, Padova, Italy



www.microfluidics2026.it

Aims, Scopes, Logistics

When?

The Microfluidic Horizons 2026 conference is preceded by a **two-day** series of Short Courses on **16 and 17 May 2026**.

Where?

Please notice, that the Short Courses will take place in the rooms of the [Department of Physics and Astronomy “G. Galilei”, University of Padua](#). This is a **different location** respect to the main Conference Venue.

Who?

The Short Courses will cover the principles of microfluidic technology and its application to the life sciences. Designed **primarily for PhD students and postdoctoral researchers**, the courses aim to build a solid conceptual and practical foundation before engaging in the MH26 conference.

What?

Through a combination of **lectures and live demonstrations**, participants will gain hands-on insight into the design and execution of microfluidic experiments, while also exploring key techniques in cell biology and biomedicine.

Lecture Streams

The Short Courses are organized in two parallel sessions:

1. **Microfluidics in Room Rostagni** starting on **16 May 2026 at 2:30 pm**.
2. **Biotechnology in Room B** starting on **16 May 2026 at 2:30 pm**.

Limitations

Participation is limited to **40 attendees** per session to ensure an interactive, hands-on learning experience. Priority will be given to **PhDs** and **Postdocs**.

Short Courses Agenda

Day	Location	Time	Microfluidics (Room Rostagni, DFA)	Biotechnology (Room B, DFA)
Saturday 16 th	Via Paolotti 9, Padova Dept. of Physics and Astronomy (DFA)	14.30-16.00	(M1) Fluid mechanics at the micro/nanoscales	(B1) Principles of cell structure
		16.00-16.15	Break	
		16.15-17.45	(M2) Microfabrication: From design to device	(B2.1) Electrical properties of cell surface (B2.2) Epigenetic regulation of cell phenotype
Sunday 17 th	Via Paolotti 9, Padova Dept. of Physics and Astronomy (DFA)	9.00-10.30	(M3) Flow control strategies at the microscale (micro - plumbing)	(B3.1) Mechanotransduction in cells (B3.2) Tracking cell behavior
		10.30-10.45	Break	
		10.45-12.15	(M4) Controlling microenvironments: On-chip and off-chip approaches	(B4.1) Engineering cell biology (B4.2) Cell communication in biological systems
		12.15-13.45	Lunch	
		13.45-15.15	(M5) Readout strategies in microfluidics	(B5) Microfluidics in clinical practice
		15.15-15.30	Break	
		15.30-17.00	(M6) Numerical approaches in microfluids	(B6) Setting up organ-on-chip systems
		17.15	Plenary Lecture Kick off of Microfluidic Horizons 2026	

* Schematic summary of the daily program

Microfluidics Stream

Lecture M1 - Fluid mechanics at the micro/nanoscales

16 May 2026 | 2:30 pm | Room Rostagni

In this lecture, we will present the fundamental principles of fluid mechanics at the micro- and nanoscales those governing the behavior of liquids in microfluidic systems where surface forces dominate over inertia.

We will discuss the key differences between microscale flows and conventional fluid dynamics, including low Reynolds number regimes, mixing characteristics, and the critical role of interfacial phenomena. Finally, we will explore applications in microfluidics, highlighting how these principles enable precise control of transport processes.

Lecture M2 - Microfabrication: From design to device

16 May 2026 | 4:15 pm | Room Rostagni

This lecture provides an overview of microfabrication, the set of techniques that enable the creation of microscale structures and devices.

We will cover the entire process from design principles and material selection to fabrication methods such as photolithography, soft lithography, and etching. Emphasis will be placed on how these techniques translate concepts into functional devices for applications in microfluidics.

Lecture M3 - Flow control strategies at the microscale

17 May 2026 | 9:00 am | Room Rostagni

Precise flow control is essential for the functionality of microfluidic systems, where miniaturization introduces unique challenges and opportunities.

This lecture will cover the main strategies for controlling fluid flow at the microscale, discussing the principles behind these methods, their advantages and limitations, and how they can be combined for complex operations.

Finally, we will look at practical examples and connectors such as tubing, fittings, and interface solutions that enable reliable integration of these strategies into real-world microfluidic devices.

Microfluidics Stream

Lecture M4 - Controlling microenvironments: On-chip and off-chip approaches

17 May 2026 | 9:00 am | Room Rostagni

Microfluidic systems rely on precise control of their microenvironment to ensure reproducibility and functionality. This lecture will explore strategies for controlling key parameters such as temperature, gas composition, and electric fields both on-chip and off-chip. We will discuss the underlying principles and practical implementation, including connectors and interface solutions that enable reliable coupling between chips and external systems.

Real-world examples will illustrate how these approaches support applications in diagnostics, biophysics, chemistry, and material science.

Lecture M5 - Readout strategies in microfluidics

17 May 2026 | 1:45 pm | Room Rostagni

Accurate and efficient readouts are essential for extracting meaningful data from microfluidic systems. This lecture will cover the main strategies for detecting and analyzing outputs, including imaging techniques, chemical and biochemical assays, and integrated sensor technologies. We will discuss the principles behind these approaches, their advantages and limitations, and how to select the right method for specific applications. Practical examples will illustrate how readout strategies are implemented in diagnostics, biophysics, chemistry, and material science.

Biotechnology Stream

Lecture B2.1 - Electrical properties of cell surface

16 May 2026 | 4:15 pm | Room B, DFA

Cell envelopes are electrically active structures defined by surface charges, membrane potentials, and ion gradients. This lecture introduces the fundamental bioelectrical properties of cell membranes and explains how they regulate interactions with the extracellular matrix, nanostructured materials, and surrounding fluids. We discuss how bioelectrical properties are exploited for cell manipulation and separation. Emphasis is placed on linking measurable electrical properties to biological function, and on how external electrical fields can trigger intracellular signaling and cellular responses.

Lecture B2.1 - Electrical properties of cell surface

16 May 2026 | 4:15 pm | Room B, DFA

Cells exhibit a broad diversity of external structures, ranging from lipid membranes and cell walls in eukaryotic cells and yeasts to capsules, envelopes, and protein coats in bacteria and viruses. This lecture introduces the structural organization of prokaryotic and eukaryotic cell surfaces and their interactions with the extracellular matrix under physiological conditions. Emphasis is placed on how the surface architecture and composition regulate cell adhesion, viability, growth, and replication. These concepts provide the biological foundation for understanding how cells respond to external cues.

Lecture B2.2 - Epigenetic regulation of cell phenotype

16 May 2026 | 5:00 pm | Room B, DFA

Even sharing the same genome, cells can exhibit strikingly different phenotypes depending on how genes are regulated. This lecture introduces the main epigenetic mechanisms, including chromatin remodeling, DNA methylation, and histone modifications, that control gene accessibility and expression. We examine how environmental cues and external stimuli modulate transcriptional programs and protein processing. Emphasis is placed on understanding epigenetic regulation as a dynamic process. These concepts are essential for interpreting cellular responses under physiological conditions and in confined and engineered microfluidic environments.

Biotechnology Stream

Lecture B3.1 - Mechanotransduction in cells

17 May 2026 | 9:00 am | Room B, DFA

Cells dynamically sense and respond to the mechanical properties of their environment, including stiffness, confinement, tension, and fluid-induced shear stress. This lecture explains how extracellular mechanical forces are detected at the cell surface and converted into intracellular biochemical signals. We introduce the main mechanotransduction pathways and describe their impact on cytoskeletal remodeling, cell adhesion strength, differentiation programs, and cell fate decisions. Emphasis is placed on the role of force transmission across membranes and adhesion complexes. Microfluidic platforms are powerful tools for controlling mechanical cues and probing cellular mechanosensitivity.

Lecture B3.2 - Tracking cell behavior

17 May 2026 | 9:45 am | Room B, DFA

This lecture introduces biological readouts and quantitative approaches for monitoring cellular behavior over time, including changes in morphology, signaling, motility, proliferation, and fate decisions. We discuss labeling strategies, genetic and chemical reporters, imaging modalities, and data acquisition methods compatible with live-cell experiments, taking into account experimental limitations. Particular emphasis is placed on computational analysis and data extraction from time-resolved measurements. The goal is to connect observable cellular behaviors with the underlying biological processes that drive them. Tracking approaches specifically designed for integration with microfluidic platforms are also presented.

Biotechnology Stream

Lecture B4.1 - Engineering cell biology

17 May 2026 | 10:45 am | Room B, DFA

Synthetic biology provides a systematic platform for designing and reprogramming cellular functions. This lecture introduces the fundamental strategies for genetic manipulation, including gene cloning, genome editing, and the construction of genetic circuits, inducible systems, and engineered feedback loops. Synthetic biology in microfluidics enables precise control over cellular environments, prediction of perturbations, and selection of single traits within a cellular population. Applications range from biosensing and signal processing to programmed cellular behaviors. Emphasis is placed on data-driven approaches for quantifying responses and inferring functional relationships in complex biological systems.

Lecture B4.2 - Cell communication in biological systems

17 May 2026 | 11:30 am | Room B, DFA

Cells communicate through chemical, mechanical, and electrical signals to coordinate behavior at the population and tissue levels. Understanding these communication mechanisms is essential for interpreting collective cellular dynamics during development, differentiation, immune responses, and infectious processes. This lecture compares communication strategies in prokaryotic and eukaryotic systems, ranging from diffusible signaling molecules to contact-dependent interactions. We discuss the role of environmental factors, spatial organization, and transport processes in shaping communication networks. Microfluidic platforms are presented as powerful tools for isolating, controlling, and quantifying cell-to-cell communication and population-level responses under well-defined conditions.

Biotechnology Stream

Lecture B5 - Microfluidics in clinical practice

17 May 2026 | 1:45 pm | Room B, DFA

Despite their strong potential, microfluidic technologies still face significant barriers to clinical adoption. This lecture examines the main challenges in translating microfluidic platforms from the laboratory to real clinical settings, including robustness, reproducibility, standardization, regulatory constraints, and biological variability. Through selected case studies -such as liquid biopsies, antimicrobial susceptibility testing, and the detection of emerging or rare pathogens- we highlight both successful and unsuccessful translation attempts. Particular attention is given to clinically relevant biological complexities, including dormant bacterial states, genetic versus phenotypic antibiotic resistance, and the limitations of current diagnostic assays for screening and disease staging.

Lecture B6 - Setting up organ-on-chip systems

17 May 2026 | 3:30 pm | Room B, DFA

Organ-on-chip platforms aim to recapitulate key structural and functional features of human tissues in controlled in vitro environments. This lecture introduces the biological principles underlying organ-on-chip design, including cell differentiation, tissue-specific architecture, dynamic cell-cell and cell-matrix interactions, and the role of mechanical and biochemical cues. Emphasis is placed on how microfluidic design choices (geometry, flow conditions, material properties, and co-culture strategies) determine physiological relevance and experimental robustness. Drawing on practical examples, the lecture provides a framework for building, validating, and interpreting organ-on-chip models for biological and translational applications.

Patronage



UNIVERSITÀ
DEGLI STUDI
DI PADOVA



Dipartimento
di Fisica
e Astronomia
Galileo Galilei



DIPARTIMENTO
DI INGEGNERIA
DELL'INFORMAZIONE



ETH zürich



DI
C
Ma
PI



THE UNIVERSITY
of EDINBURGH

Sponsors



Dipartimento
di Fisica
e Astronomia
Galileo Galilei



PhD Program in Materials
Science & Technology,
University of Padua (Italy)

PhD Program in Physics,
University of Padua (Italy)



Contacts

microfluidics2026@dfa.unipd.it

More information at

microfluidics2026.it/short-courses

Microfluidic Horizons 2026

Exploring Frontiers in Physical
Chemical & Biomedical Sciences

www.microfluidics2026.it

