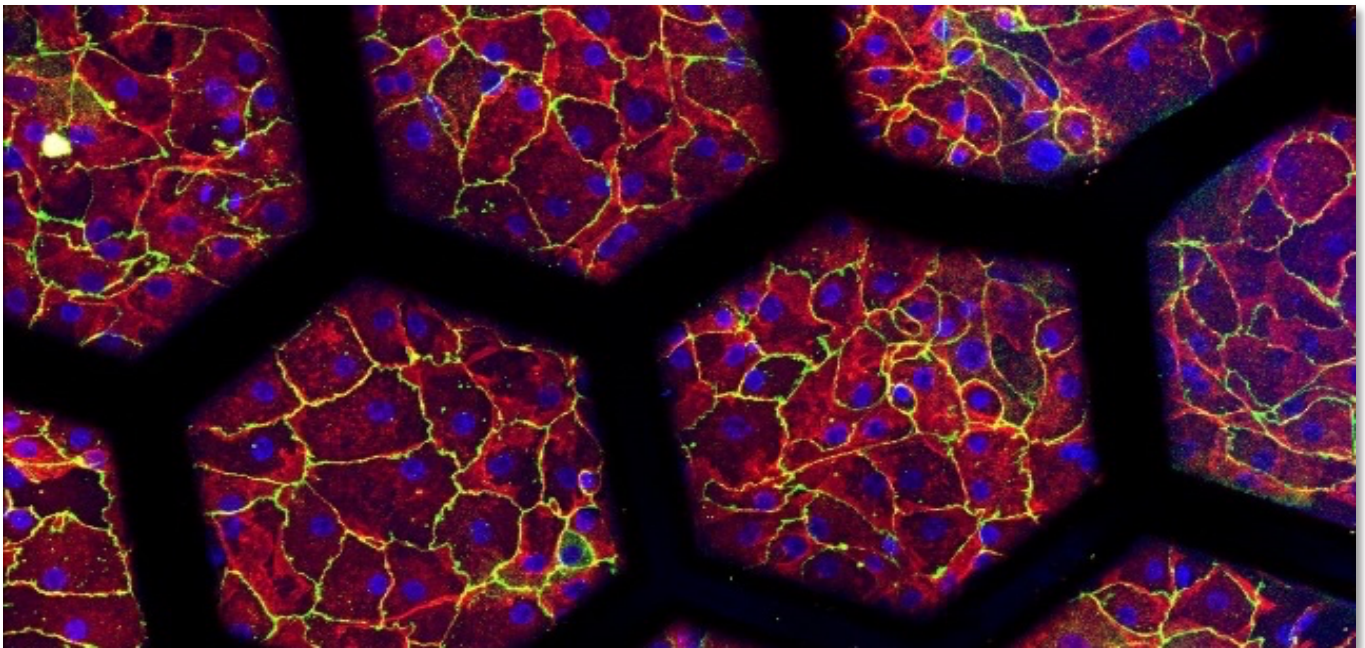


ARTORG Center Organs-on-Chip Facility (OOCF)

P. Zamprogno, Univ. Bern, ARTORG Center
2nd generation lung-on-chip, Nat. Commun. Biol. 2021



OOCF Annual Report 2020

March 10th, 2021

OOCF Annual Report 2020

OOCF Introduction and Vision

To answer the growing interest and demand from many researchers regarding organs-on-chip technologies, the ARTORG Center created several years ago the Organs-on-Chip Facility (OOCF). The objective of the OOCF is to provide scientists from the University of Bern, the University Hospital of Bern and beyond a state-of-the-art infrastructure and a support to design, produce and test organs-on-chip systems. The facility is part of the ARTORG Organs-on-Chip Technologies (OOC) laboratory headed by Prof. Olivier Guenat. Due to its unique position at the interface between engineering, microfluidics and cell biology, the OOC lab has acquired along the years state-of-the-art microfabrication equipment, in particular for soft lithography, as well as for testing and imaging organs-on-chip.

In 2020, despite the COVID-19 pandemic, during which the OOCF was closed for several weeks, 32 researchers from 7 research groups (6 from the University of Bern, one external) used the OOCF facility. The OOCF includes two laboratories, the BioMEMS and the OOC culture laboratories and is maintained by a dedicated team.

BioMEMS Laboratory

The BioMEMS (bio-micro-electromechanical systems) lab is located at the ARTORG Center, floor E (E408). The 40m² lab comprises three parts: the first is aimed at designing microfluidic devices by computer assisted design (CAD) and numerical simulation, the second at producing microfluidic devices and the third at testing microfluidic devices. The typical production of a microfluidic device is based on soft lithography that consists in the production of a 3D micromold, produced either by stereolithography, by 3D printing or by silicon micromachining depending on the required precision and budget. Once the mold is produced, a liquid elastomer (polydimethylsiloxane (PDMS)) is poured on the mold, cured and removed. The PDMS part is then plasma O₂ activated and bonded to a glass plate.

In 2020, a Zeiss Axio Imager was purchased (see OOC microscopy section below) to replace the 15 years old Zeiss Axioplan. For the equipment of the BioMEMS lab, please visit the following [website](#), or contact Rrahim Gashi, lab manager of the BioMEMS lab. He is in charge among others for the lab introduction for new users and is available to provide an introduction to specific equipment (spin-coater, PDMS mixer, O₂ plasma reactor,...): rrahim.gashi@artorg.unibe.ch

Organs-on-Chip Culture Laboratory

The OOC culture laboratory is located at the ARTORG Center, floor U1. The 55m² is a BSL-2 cell culture laboratory that requires a specific training prior to be authorized to use it. A number of investments were made in 2020. A new refrigerated centrifuge aimed for potentially infected patients' materials (BSL2 requirements) was purchased. A new microscope EVOS M7000 (see OOC microscopy section below) was acquired for the automated long-term imaging of OOC systems. Finally, a set of TEER electrodes (96-well format) and its controller (from WPI) was bought to complement the existing one. The latter enables the measurement of a wider range of impedance (1-100k Ω) and offers lower noise and greater resolution and accuracy.

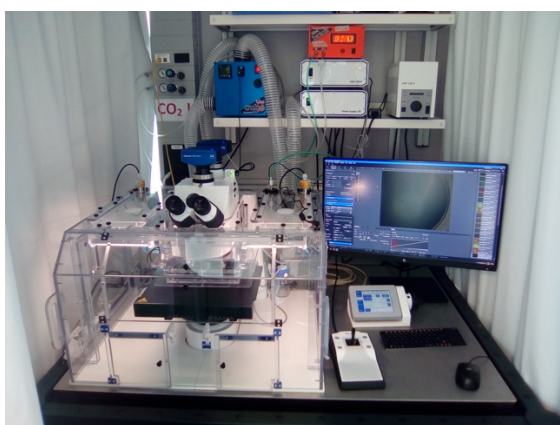
For the equipment of the OOC culture lab, please visit the following [website](#), or contact Sonja Gempeler, lab manager of the OOC culture lab. She is also in charge for the lab introduction and

authorization to work in the BSL-2 laboratory. Please contact her if you need support and/or an introduction to the OOC cell culture lab: sonja.gempeler@artorg.unibe.ch

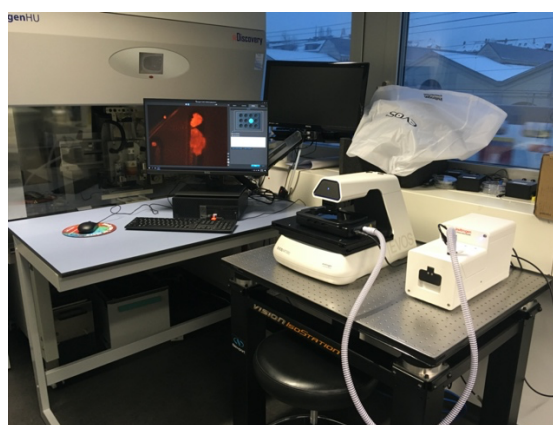
Organs-on-Chip Microscopy

Two new microscopes were purchased in 2020. A **Zeiss Axio Imager**, which is an upright microscope with an additional environmental chamber (CO₂, humidity controlled) for both materials and life sciences. It replaces a 15-year-old Zeiss Axioplan 2, for which no spare parts can be purchased anymore. It is located in the BioMEMS lab. The second microscope that was acquired in 2020, a **Thermo Fischer EVOS M7000**, is a user-friendly and automated microscope particularly well adapted for time-lapse imaging in OOC systems. An environmental box (CO₂ and humidity controlled) makes it possible to image cells for a long period of time. The EVOS is located in the OOC culture laboratory.

Dario Ferrari is responsible for both microscopes, please contact him if you want to use and get introduced to them: dario.ferrari@artorg.unibe.ch



Zeiss Axio Imager M2



Thermo Fischer EVOS M7000

Table: Investment in 2020 in the OOCF

Equipment	Reason for investment/replacement	Price (in CHF)
EVOM3 + STX100C96	New TEER measurement specific for organs-on-chip barriers, with 96 wells electrodes	5'390
Zeiss Axio Imager M2	Replacement of old upright Zeiss microscope with environmental box (CO ₂ and humidity)	84'097*
Thermo Fischer EVOS microscope with environmental box	Automated time-lapse imaging for (perfused) OOC systems	79'999
TOTAL investment 2020		169'486

* partial funding (78'022CHF) received from the Ressourcenausschuss of the medical faculty

OOCF Usage

Due to the COVID pandemic, the specific rules defined by the University of Bern (social distance, mask and maximum number of persons per lab (**min. 10m²/pers.**)) have to be respected in the OOCF laboratories. We are aware that the BioMEMS lab is small for the number of users. The current social distance rules do of course exacerbate the situation. To provide a working environment that is as good as possible, the laboratories need to be reserved via google calendar. To ease the registration, we recently added a stationary iPad to register/reserve on-site (see picture).



iPAD set-up in the BioMEMS lab

Important for all new users, a laboratory introduction provided by one of the lab managers is mandatory. This includes MSc and interns accompanying PhD students/postdocs.

ARTORG OOCF User Fees (& SNF)

To keep the administrative costs as low as possible, an affordable yearly user fee is requested to each research group (typically 2-3 users/group) that uses the OOCF. The user fees are unchanged from last year. The user fees for the OOC culture lab were redefined in function of the frequency of the lab use. The fees aim at covering parts of the running costs of the laboratories (repair costs, replacement of equipment), the costs of the consumables, and a small part of the salary of the OOCF staff. If you need large volumes of consumables (PDMS, medium, etc.), please inform the respective lab manager, so that we don't run out of stock (the additional costs will be billed separately). The microscope user fees are aligned with those defined by the MIC group of the University of Bern.

Important, we encourage each PIs to add OOCF user fees in their SNF research proposals.

The OOCF also offers to design customized organs-on-chip. This can range from helping to create basic soft lithography molds (CAD) to the complete design of complex organs-on-chip. To assess your needs, contact: olivier.guenat@artorg.unibe.ch

Table: OOCF User Fees (prices in CHF)

Services	What	Users Uni Bern	External Users
BioMEMS-Lab	Introduction ¹⁾	30.-	50.-
	Year	1500.-	On demand
Organ-on-Chip Culture Lab	Introduction ¹⁾	30.-	50.-
	Year – occasional users (5-10x/yr)	1500.-	On demand
	Year – regular users (10-20x/yr)	3000.-	NA
	Year – frequent users (>20x/yr - weekly)	6000.-	NA
Zeiss Axio-Imager M2	Instructions ²⁾	50.-	100.-
	Use (per hour) ³⁾	25.-	50.-
EVOS Thermo	Instructions ²⁾	50.-	100.-
	Use (per hour) ²⁾	On demand	On demand
Spin-Coater	Instructions	50.-	100.-
Plasma-Cleaner	Instructions	50.-	100.-
OOC design	Design customized organ-on-chip	On demand	On demand

¹⁾ The general introduction must be completed regardless of whether the lab is used only once or on a regular basis, Contact the responsible lab manager.

²⁾ please contact Dario Ferrari (Dario.ferrari@artorg.unibe.ch)

³⁾ If extra support is required by the lab technician, an additional 100.- per hour will be charged

Development of the OOCF

The rising interest for organs-on-chip, which we also observe within the medical faculty of the University of Bern, is a great sign that OOC technology is seen as a potential solution for in-vitro disease modelling. In the OOCF, we witness this interest with the increasing number of OOCF users. This obviously comes at a cost, the OOCF laboratories are becoming too small to provide the necessary working environment for all users. We are currently trying to find a suitable solution with the faculty.

Acknowledgments

The OOCF is deeply grateful for the support of the Resource Committee (“Ressourcenausschuss”) of the Medical Faculty of the University of Bern, which generously funded a large part of the Zeiss Axio Imager M2 microscope.

Bern, April 7th, 2021.

Olivier Guenat - ARTORG Organs-on-Chip Facility