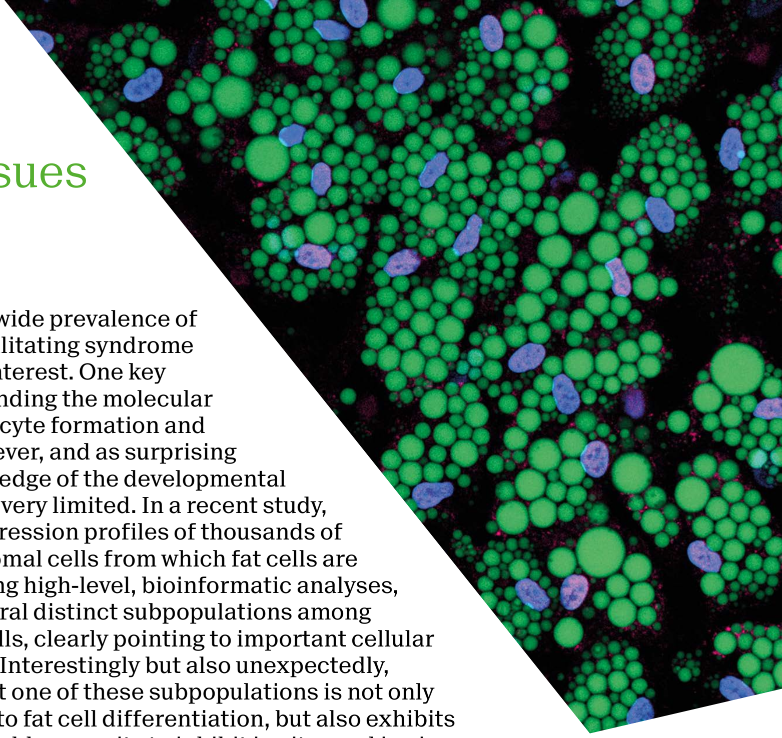
MASTER

LIFE SCIENCES ENGINEERING

EPFL

This master program offers a cross-disciplinary training for the next generation of engineer-scientists who will apply their skills and knowledge to address fundamental and applied research questions in Life Sciences Engineering.

Students may choose to deepen their knowledge in relevant Specializations. Alternatively, they may complete a Minor.



Dissecting fat tissues one cell at a time

Prof. Bart Deplancke

Given the striking increase in the worldwide prevalence of obesity, studying the onset of this debilitating syndrome and its physiopathology is of great interest. One key aspect of such studies is understanding the molecular mechanisms that mediate adipocyte formation and adipose tissue plasticity. However, and as surprising as this may sound, our knowledge of the developmental origin of adipocytes is still very limited. In a recent study, we mapped the gene expression profiles of thousands of individual adipose stromal cells from which fat cells are thought to arise. Using high-level, bioinformatic analyses, we uncovered several distinct subpopulations among those stromal cells, clearly pointing to important cellular heterogeneity. Interestingly but also unexpectedly, we found that one of these subpopulations is not only refractory to fat cell differentiation, but also exhibits a remarkable capacity to inhibit in vitro and in vivo mammalian adipocyte formation. Consequently, we decided to name this novel cell type, Aregs, for Adipogenesis Regulators. This finding is of great biomedical interest, not only because it provides new insights into how the plasticity of fat depots may be regulated, but also potentially into how often undesired adipocyte accumulation in other systems such as the muscle and bone marrow could be controlled.

Watch the video:

Sakura Nussbaum:
“Becoming a part of such a diversified network of engineers ready to fight all kinds of health issues is the most exciting about this curriculum!”

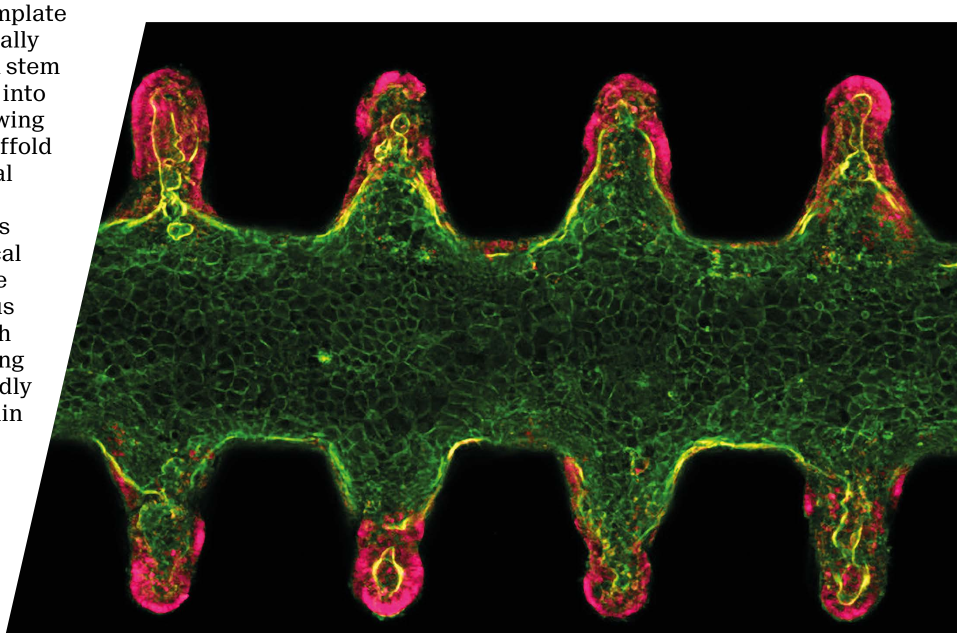
Bioengineering long-lived ‘mini-gut’ tubes

Prof. Matthias Lutolf

Tissue and organ biology are very challenging to study in mammals, and progress can be hindered, particularly in humans, by sample accessibility and ethical concerns. However, advances in stem cell culture have made it possible to derive in vitro miniature tissues called ‘organoids’, which capture some of the key multicellular, anatomical and even functional hallmarks of real organs. Current organoid technologies however invariably result in tissues with a closed, cystic architecture that restricts lifespan and size and limits experimental manipulation.

András Ecker:
“I had one clear drive for applying to the Life Science master's at EPFL: I wanted to study neuroscience from the bests, among the best in Europe. In addition I also got a highly stimulating multicultural environment and beautiful nature.”

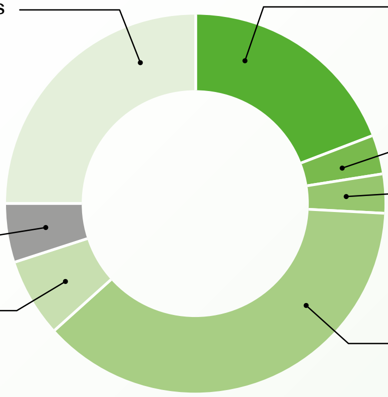
In a recent study, we have engineered bioartificial hydrogel scaffolds, providing cell-adhesive interactions and gut-shaped 3D micro-topography, as a template for extrinsically guiding intestinal stem cell (ISC) development into open, tubular ‘mini-guts’. Owing to the in vivo-like anatomical scaffold structure, ISCs undergo a stereotypical cell-fate patterning process that results in an in vivo-like spatial arrangement of crypt/villus domains. Tubular mini-guts retain key physiological hallmarks of native intestine, such as the digestive function of enterocytes and the secretion of mucus by goblet cells, and they readily support the growth of microbiota. This concept for extrinsically guiding stem cell self-organization processes can be broadly applicable for existing epithelial organoids to attain more physiologically relevant sizes, shapes and functions.



Master of Science in

LIFE SCIENCES ENGINEERING

2-year program - 120 ECTS



Students may choose a 30 ECTS specialization:

B Biomedical engineering
J Molecular health
K Biological data science
L Neuroscience

Or opt for a 30 ECTS minor included in the 120 ECTS. Minors recommended with this Master:

- Biomedical technologies
- Biotechnology
- Computational biology
- Data science
- Engineering for sustainability
- Imaging
- Management, technology, entrepreneurship
- Neuro-X
- Physics of living systems

	Specializations				Credits
Core courses	B	J	K	L	23
Core courses in Life sciences engineering					11
Genomics and bioinformatics					4
Stem cells and organoids					3
Life Sciences engineering: genome to function					4
Core courses in engineering and computation					12
Applied biostatistics	B	J			5
Applied biomedical signal processing					4
Applied data analysis			K		8
Applied probability and stochastic processes					4
Biomicroscopy I	B			L	3
Dynamical system theory for engineers					6
Image processing I					3
Machine learning					8
Scientific thinking					4
Scientific literature analysis in:					
Bioengineering					4
Computational molecular biology					4
Neuroscience					4
Scientific project design in:					
Cell and developmental biology					4
Drug discovery					4
Integrative neurosciences					4
Translational oncology					4

School of Life Sciences
go.epfl.ch/master-life-sciences-engineering
contact: master.lse@epfl.ch

	Specializations				Credits
Innovation and entrepreneurship	B	J	K	L	4
Concept to early-stage drug and medtech products					4
Entrepreneurship in food and nutrition science					4
Entrepreneurship in life sciences					4
Innovation management in the digital age					4
Introduction au droit et à l'éthique					4

Options					45
Advanced bioengineering methods laboratory					4
Artificial neural networks/reinforcement learning					6
Basics in bioinstrumentation					4
Bioimage informatics					4
Biomaterials					2
Biomechanics of the cardiovascular system	B				3
Biomechanics of the musculoskeletal system	B				5
Biomedical optics	B				3
Biomicroscopy II					4
Biophysics: physics of biological systems					4
Biophysics: physics of the cell					3
Biostatistics			K		5
Brain-like computation and intelligence					4
Cancer biology I		J			5
Cancer biology II					5
Causal thinking					5
Computational cell biology			K		4
Computational motor control					4
Computational neurosciences: biophysics					5
Computational neurosciences: neuronal dynamics			K	L	5
Controlling behavior in animals and robots					4
Deep learning					4
Deep learning in biomedicine			K		6
Digital epidemiology			K		4
Frontiers in chemical biology					3
Fundamentals of biomedical imaging	B				4
Fundamentals of biophotonics	B				3
Fundamentals of biosensors and electronic biochips	B			L	3
iGEM					12
iGEM lab					6
Image analysis and pattern recognition					4
Image processing II					3
Imaging optics					3
Immunoengineering		J			4
Immunology - advances and therapeutic implications		J			5
Infection biology		J			5
Introduction to natural language processing			K		6
Lab immersion I	B	J	K	L	8
Lab immersion II	B	J	K	L	8
Lab immersion III (semester project)					12
Lab immersion academic (outside EPFL) or in industry					22
Lab on cell-free synthetic biology					4
Linear models					5
Management of intellectual property					3
Mechanobiology: how mechanics regulate life					3
Methods: from disease models to therapy					4
Methods: omics in biomedical research					4
Micro- and nanorobotics					3
Modern natural language processing					8
Molecular endocrinology		J			4
Nanobiotechnology					3
Neural circuits of motivated behaviors				L	4
Neural interfaces					6
Neural signal and signal processing				L	6
Neuroscience				L	4
Neuroscience: behavior and cognition				L	5
Neuroscience: cellular and circuit mechanisms				L	5
Neuroscience: from molecular mechanisms to disease				L	5
New tools and research strategies in personalized health	B	J			4
Nutrition: from molecules to health		J			4
Pharmacology and pharmacokinetics					2
Physics of life					4
Planetary health					4
Principles and applications of systems biology			K		3
Randomness and information in biological data			K		4
Sensors in medical instrumentation	B				3
Single cell biology		J	K	L	4
Statistical physics of biomacromolecules					4
Statistics for data science					6
Structural biology		J	K		4
Structural mechanics	B	J			4
Synthetic biology				L	4
Systems neuroscience				L	4
The software enterprise - from ideas to products					8
Translational neuroengineering					6
Understanding statistics and experimental design					4