Understanding resilience mechanisms in marine restoration.
Contact: Prof. Laura Airoldi, e-mail: laura.airoldi@unipd.it

Habitat restoration is an emerging field to actively reverse the degradation and loss of natural ecosystems, recognized by the recently announced UN Decade on Ecosystem Restoration (2021–2030). It often focuses on enhancing the abundance or distribution of habitat-forming organisms such as salt marshes, canopy algae, oyster reefs, and seagrasses, to reinstating ecosystem services like carbon and nitrogen sequestration, coastal protection, and habitat provisioning. At the same time, restoration in a marine context is often challenging because of the open and dynamic nature of the system, and because of the long-term uncertainties of restoration outcomes in the face of future climate changes. In this complex context, identifying and understanding the multiple, self-reinforcing feedbacks that can increase the resilience of restoration efforts is a major research priority. The project focuses on the large restoration projects that have occurred in Venice Lagoon during the past 30 years (11 km^2 of artificial salt marshes constructed/reconstructed over to tackle erosion and numerous seagrass transplantations). We will use a combination of field sampling and controlled field and lab experiments to identify: i) the mechanisms and feedbacks that are likely to affect the success of restoration of marine vegetation; ii) whether those mechanisms vary over time or in response to strong environmental gradients (e.g. in salinity, hydrodynamics or temperature); iii) What are the corresponding levels of key variables (e.g. plant density, cover, extent or biomass) and key process variables (e.g. grazing rates, sediment trapping, nutrient reduction rates) required to support the desirable feedbacks; and iv) how those mechanisms can support the resilience of vegetation to climate change, especially to marine heatwaves that are increasing. The successful applicant should have a background in one or more of the following fields: marine ecology, restoration ecology, experimental ecology. Training in Scientific Diving, or at least evidence of capability to work in the field in the sea (i.e. capability to swim) is also requested, as well as English language proficiency. Data analysis proficiency with R is regarded as an advantage.

Developing a model of the innervated heart using human induced pluripotent stem cells.
Contact: Prof. Milena Bellin, e-mail: milena.bellin@unipd.it

Innervation of the heart contributes to both physiological heart function and to pathological conditions. In this project we will differentiate human induced pluripotent stem cells (hiPSCs) into sympathetic neurons and use them to innervate hiPSC-derived cardiac microtissues. Both transcriptional and functional characterization will be used to assess reciprocal influence and functional coupling between neurons and cardiomyocytes. This model will assist the dissection of the myocardial sympathetic function in several cardiac diseases.

We offer an international environment and cutting-edge technology.

Patient-specific cardiac microtissues for studying inherited cardiac diseases
Contact: Prof. Milena Bellin, e-mail: milena.bellin@unipd.it

We have recently developed a cardiac microtissue model from human induced pluripotent stem cells (hiPSCs), composed of cardiomyocytes, endothelial cells, and cardiac fibroblasts. These “mini-hearts” can be used to study inherited cardiac diseases caused by specific gene mutations. This project will explore the molecular and cellular mechanisms underlying cardiac disease onset and progression by means of transcriptional, functional, and metabolic analysis. The diseased microtissues will also be used to test potential pharmacological treatments.

We offer an international environment and cutting-edge technology.

Analysis of bioactive peptides with bioinformatics approaches for the enhancement of agri-food by-products.
Contact: Prof. Stefano Campanaro, e-mail: stefano.campanaro@unipd.it

One of the crucial issues of our agri-food systems concerns the huge volume of resources that are wasted; however, protein-rich by-products may represent a natural resource of bioactive peptides (BP). The general objective of the project is the exploitation of different categories of by-products for the recovery of BP to be used in the food industry. Fermentation guided by microbial strains or selected consortia, combined with enzymatic hydrolysis and other treatments will be used for the release of BP from by-products. The focus of the project will be the selection of precursors for obtaining BP, as well as the study of the link between microbial strains and protease coding genes. For this purpose, approaches for the in-silico analysis of the by-product proteome will be developed in order to select and predict the potential yield of BP. The microbial genomes deposited in the databases will be the source for the identification of the genes coding for the proteolytic activities of interest.

The Pluripotency Program in Human Embryonic Stem Cells.
Contact: Prof. Graziano Martello, e-mail: graziano.martello@unipd.it

This proposed project draws from a longstanding interdisciplinary collaboration between the Prof. Graziano Martello and Microsoft Research in the domain of computational modelling of pluripotent stem cells. The project makes use of our previous work and extends the research focus to human pluripotency - the unique state in which a stem cell is poised to generate all lineages of the adult body. The aim of the proposed project is to uncover the biological program governing pluripotency in humans, and to utilise this understanding to inform reprogramming protocols, as well as our understanding of stem cell differentiation. The candidate should have a strong background in analysis of biological data and computational modelling.

Development of a hybrid approach based on biocatalytic and bioinformatic tools for treatment of CO2-rich streams and conversion into biopolymers.
Contact: Prof. Tomas Morosinotto, e-mail: tomas.morosinotto@unipd.it

The exploitation of CO_2 capture, utilization and storage technologies (CCUS) in industrial applications face significant challenges due to the high investment cost and the fierce international competition in the sectors concerned. The project has an absolute aim to accelerate the use of CCUS and revolutionize CO_2 capture and utilization by closing carbon loops in a circular economy approach. Thus, the project targets to develop and demonstrate a novel biotechnological platform in which CO_2 is converted into upgraded biofuels and high market value platform chemicals, namely biosuccinic acid (bioSA) and polyhydroxyalkanoates (PHAs). Facultative anaerobic microorganisms are the best choice to use a mixture of CO_2 and food processing waste as feedstock, producing PHAs or bioSA that form the building blocks of various biopolymers and bioproducts. The project will focus on the optimization of platform chemicals synthesis by biocatalysts (e.g. *Cupriavidus necator, Synechocystis* sp. and *Anaerobiospirillum succiniciproducens*) with systems biology, combining transcriptomic analyses in different conditions with metabolic modeling. The impact of natural and engineered strains' genomic variants on PHA or bioSA yield will be evaluated, as well as the feedstock composition. Results will originate new value chains for production of platform chemicals as an alternative to current synthesis starting from expensive feedstock.

The role of the Epac1/Rap1 pathway in endomembrane system organization downstream of mitochondrial dynamics.
Contact: Prof. Luca Scorrano, e-mail: luca.scorrano@unipd.it

Mitochondria are dynamic organelles: their shape and morphology continuously adapt to the changing cellular environment. Reciprocally, changes in mitochondrial shape are sensed by the nucleus and participate in key signaling cascades regulating cell death, autophagy, differentiation, innate immunity. The orchestration of these complex pathways requires retrograde signals that our laboratory contributed to elucidate over the last years, and the coordination of mitochondrial morphology with that of the endomembrane system, including endoplasmic reticulum, endosome, Golgi and lysosomes. However, how changes in mitochondrial shape control organization of these other organelles is largely unknown. The PhD student will analyze the role of a signaling cascade that in unbiased experiments was found to be

modulated upon deletion of Opa1 in the organization and localization of the endomembrane system, by using advanced imaging, genetic approaches, biochemistry and cell biology experiments.

Combined strategies for CO2 capture and hybrid energy storage optimization including microbial management and metagenomics.
Contact: Dr Laura Treu, e-mail: laura.treu@unipd.it

Life CO2toCH4 aims at developing and demonstrating an innovative, integrated, and sustainable industrial process for simultaneous energy storage and CO2 capture and utilization (CCU). The technology relies on the fact that the Renewable Energy Sources (RES) will be used for water electrolysis, and subsequently the produced H2 will be biologically converted into methane (as a non-fossil biofuel) together with CO2 from exhaust gasses. To maximize the efficiency of methanation, technically advanced systems will be developed by using control architectures based on microbial resource management and computational biology. The currently restricted capacity of the power-to-gas concept will be expanded to use impure CO2 sources by using mixed microbial consortia that are more robust than pure cultures. Microbial monitoring of the archaea population will ensure that the H2 and CO2 will be converted to CH4 and not follow a different metabolic route for acetic acid production (i.e. to avoid homoacetogenesis). To physiologically monitor the microbial activity, metagenomics and, subsequently, genome-scale computational models of microbial populations will be used as a platform for biochemical data integration and interpretation. The process will thus be optimized by routing the fluxes of intermediate metabolic products, evaluating carbon and electron balances and will be coupled with in-depth molecular analysis. Such optimization will be guided by machine learning models combining process monitoring data and model simulations. This project will contribute to the implementation of the European Union policy and legislation on the promotion of the advanced biofuels, circular economy and on sustainable waste management.

Environmental DNA application to coastal marine ecosystems for the preservation of ecosystem functions and services under climate change pressure and overfishing
Contact: Prof. Lorenzo Zane, e-mail: lorenzo.zane@unipd.it

More than 60% of the economic value of the biosphere is provided by the oceans and especially coastal ecosystems. Coastal marine ecosystems harbor a high biodiversity and provide a wide array of ecosystem functions and services but are affected by a combination of anthropogenic local and global threats. The Mediterranean Sea has been concerned by major shifts in marine ecosystems, with a particularly greater overall impact to coastal areas and it is therefore important to collect biodiversity data of these ecosystems. In this project, the candidate will characterize, using environmental DNA (eDNA), the taxonomic diversity at seven locations in the Italian coast, each including protected (within Marine Protected Areas) and unprotected sites, across a wide latitudinal-temperature range that mimics the effect of climate change using a space-for-time approach. The candidate will also develop and apply a novel eDNA protocol to measure within-species genetic diversity, based on multiplex amplification and Illumina high throughput sequencing of hyper-variable markers. The research is part of the PRIN project “Preserving coastal marine ecosystem functions and services under climate change pressure and overfishing” (Prot. Prot. 2020J3W3WC) and involves the interaction with several groups with different expertise, from field work to modeling (lagrangian dispersal and trophic interactions) to the assessment of ecosystem functions and services.

Study of the metabolic alterations caused by fructose intake in the context of pancreatic carcinogenesis.
Contact: Dr Alessandro Carrer, e-mail: alessandro.carrer@vimm.it

The candidate will interrogate the effect of fructose overconsumption on pancreatic epithelial cells. Using autochthonous mouse models of spontaneous pancreatic carcinogenesis, the candidate will examine how dietary fructose impacts the formation of pre-neoplastic lesions, when compared with equivalent glucose consumption. The impact of physiological fructose consumption (aligned with daily fructose ingestion in western countries) will also be tested.

The candidate will also interrogate molecular alterations driven by fructose overconsumption. (S)he will test changes in metabolite availability, with a focus on acetyl-CoA derivates. Changes in lipid species and protein acetylation profiles will be interrogated with omic approaches.
Finally, the candidate will test whether gut microbiota might play a role on fructose-mediated effects.
The candidate will train under the supervision of experienced researchers and will be involved in all aspects of the study: experimental design, mouse handling, performing basic molecular and biochemical experiments (PCR, Western Blotting, Immunostaining, ChIP).

Soft-Gen: Software and NGS devices for Genetic determinations in clinic.
Contact: Dr Diego Boscarino, e-mail: boscarino@abanalitica.it

The project regards the development of standardised bioinformatic pipelines and software for the management, analyses and interpretation of genomic data in complex diseases. Genomic data derived from cancer patients and patients affected by hereditary diseases will be used to identify diagnostic and prognostic biomarkers, and to establish robust bioinformatic pipelines suitable for use in the clinics. Part of the project will be carried out in the DOTT. DINO PALADIN company that specialized in the development and production of diagnostic systems for professional use.

Illuminating Cholesterol-mTORC1 Signaling in Lysosomal Function and Disease.
Contacts: Dr Alessandro Carrer and Dr Roberto Zoncu, e-mail: alessandro.carrer@vimm.it - rzoncu@berkeley.edu

The candidate will test the impact of cholesterol overload on pancreatic regeneration, testing how aberrations of cholesterol trafficking impairs pancreatic cell plasticity and proliferation. At the same time, the candidate will explore the involvement of mTORC1 signaling in inflammation-induced carcinogenesis.
(S)he will examine cholesterol trafficking during murine pancreatitis and test the impact of targeting cholesterol biosynthesis on tissue regeneration. Specifically, the role of cholesterol lysosomal transporter, NPC1 will be studied, along with other cholesterol-interacting proteins at the lysosome and other organelles.
In parallel, the impact of both cholesterol trafficking and lysosomal accumulation on pancreatic cancer cell proliferation will be analyzed, and linked to mTORC1 signaling.
The candidate will train in two stimulating laboratories, splitting time both at the Veneto Institute for Molecular Medicine (Padova) and at the University of California, Berkeley (Berkeley, USA) under the supervision of two experienced group leaders. The candidate must demonstrate the ability to adapt to challenging working environments and to develop creative thinking. The candidate must be a motivated, driven person able to lead an innovative and interdisciplinary study at the crossroad between cellular biology, oncogenic signaling and animal transgenics. The candidate will design the study, perform basic molecular, biochemical and cellular experiments (PCR, qPCR, Western Blotting, Immunostaining, cell transfection, etc) and handle animal work.

Topics “Biological Signals”

The topic of these projects will coincide with one of the topics presented in each Curriculum.