SupBiotech International Summer School

One Health : a pragmatic approach through biotechnology

2025 Edition

July 4 – July 22

SYLLABUS

I. Presentation

One Health is a key concept that links human, animal and environmental health into a single framework to improve the global efficiency and sustainability of health care systems. To achieve this goal, One Health embraces the complexity of ecosystems by integrating reductionist approaches with holistic data analysis and systems thinking. Biotechnologies play a crucial role in the development of One Health. On the one hand, biotechnology offers innovative means to expand the scientific knowledge that feeds One Health. On the second hand, biotechnologies provide novel technological solutions to monitor health, preserve and restore the environment or prevent and cure diseases.

During this summer school, you will have the opportunity to learn about One Health principles, and how they are applied. You will also be introduced to systems thinking through case studies. We will illustrate how biotechnologies, including environmental biotechnologies, can integrate within One Health.

The goal of this summer school is to develop the capacity of the participants to better understand complex systems and to consider biotechnological innovation from the perspective of One Health to develop sound biotechnological solutions.

This Summer School includes lectures (22 h), hands-on training (27 h), and workshops (4 h).

II. Objectives

- Understand One Health principles
- Develop systems thinking capabilities for one health
- Improve decision-making skills and capacity to propose relevant solutions to complex problems
- Understand how biotechnologies contribute to One Health
- Develop practical skills in the evaluation of environmental impacts on human health using biotechnologies for investigations in cellular models
- Acquire knowledge and technical skills for metagenomics and evaluation of microbial biodiversity in the environment

The Summer School is intended to provide students interested in biotechnologies with key knowledge about how to use One Health concept to conceive sound biotechnological innovations.

The lecture program will be divided into two parts. The first will address One Health principles and core knowledge. The second part will illustrate the place of biotechnologies into One Health. The lecture sessions will address the following points:

- Core principles of One Health
- Underlying ecological theories
- System thinking
- Water pollution, environmental epidemiology and bioremediation
- Social barriers to innovation and change
- Genetic engineering
- Environmental cues and brain physiopathology
- Microbial biodiversity and metagenomics
- Ecotoxicology

Hands-on training will allow students to question the problem of pesticides within a One Health perspective through:

- Ecotoxicological evaluation of the impacts of pesticides using human cell lines
- Culturomics and metagenomic approaches to characterize the environmental impact of pesticides on soil microbiome
- A workshop dedicated to holistic understanding of the relationships that bridge agriculture to One Health

Practical training will be an entry door to invite students to frame into a broad picture the results obtained, and their knowledge using the One Health approach. In-depth analysis of cutting-edge scientific publications, gamification of complex thinking, and an oral presentation on systemic analysis of problems related to One Health and critical assessment of putative solutions.

III. Contents

Introduction to One Health		
Lecture 1: Introduction to One Health	This introductory lecture will describe the core principles of One Health concept including: - Introduction to Planetary Health - Interactions of humans with the biosphere - Biodiversity in the Anthropocene - Main risks of environmental change for human health - Governance in Planetary Health - Challenges and limits of one health	**3 hours**
Lecture 2: Introduction to system thinking	This module will present valuable tools used to support complex thinking: - Holistic data analysis - Causal loop diagrams - Stock and flow diagrams - System dynamics modeling - The iceberg model Students will experiment with these tools on related topics.	**3 hours**

Workshop 1	Lectures 1 and 2 will lead to a first system thinking workshop on Environment and health	**2 hours**
	Biotechnologies in One Health	
Lecture 3: **Water pollution: What are the problems? What can be the solutions?**	This lecture will describe the threats caused by human activities to water resource. A focus will be placed on microplastics and nanoplastics pollution monitoring, related risks, and impacts on health. This example will be used to illustrate the methods employed in environmental epidemiology. Solutions will be discussed including biotechnological alternatives. The importance of approaches for water bioremediation will be illustrated from the point of view of a scientist and a CEO of a water company specializing in water depollution.	**3 hours**
Lecture 4: **Understanding the social engines behind the adoption of innovation**	What are the conditions for the adoption of technological innovations for the environmental transition of agriculture. What are the changes of behaviors required? These questions will be addressed through the prism of sociology.	**3 hours**

Lecture 5: **Tweaking biodiversity with genetic engineering**	This lecture will be centered on gene edition technologies (CRISPR-Cas9), what are they? What are their promises? To ensure the complete comprehension of the following sessions regardless of students' initial formation, this lecture will provide the necessary basic knowledge required in molecular biology. This course will also drive students to consider the applications of these technologies for human, animal and plant health.	**3 hours**
Lecture 6: **Addressing microbial biodiversity and its relationship with Health**	This course will highlight the importance of microbial biodiversity for human and environmental health. Basic knowledge about bacteria and fungi will be provided. The ecosystemic functions delivered by microbes when organized into microbiota and some of the biotechnological applications will be addressed. The impact of human activities will also be questioned. We will then describe how microbiota are studied through metagenomics.	**5 hours**
Lecture 7: **Impact of Environmental cues on neurodegenerative diseases**	This lecture will review the latest understanding at molecular and cellular level on how environmental pollution contributes to neurodegenerative diseases. Relevant cellular models to study these relationships will also be presented.	**2 hours**

	Practical training: Ecotoxicological impacts of pesticides on human and environmental health	
Practical training 1: **Ecotoxicological assays to evaluate the impacts of pesticides using human cell lines**	The cytotoxicity of phytopharmaceutical compounds will be assayed on human cell lines. This training will provide hands-on experience in the execution of protocols that quantify cell growth, autophagy and cell death using colorimetric assay, live/death staining together with fluorescence microscopy and flow cytometry.	**7 hours**
Practical training 2: **Culturomics and metagenomic approaches to characterize the environmental impact of pesticides on soil microbiome**	This practical training is dedicated to the evaluation of the impact of pesticides on the microbial biodiversity of soil. Students will make a qualitative evaluation by a culturomics approach and will achieve in depth characterization of bacterial content through 16sRNA sequencing. This approach includes experimental design, sample collection, DNA extraction, library preparation, next-generation sequencing and data analysis.	**20 hours**
Workshop 2 **Complex thinking workshop: pesticides seen from the perspective One Health**	Through gamification, students will be invited to apply the concepts of system thinking to decipher the causes and consequences of pesticides usage. This workshop will allow participants to develop a full holistic picture of the relationships that entangle our agricultural model with human, animal and environmental health. Based on the result obtained, students will engage a discussion on the putative solutions and their socio-economic implications.	**2 hours**