



UNTIL DEATH DO US APART: LIVING IN A SYMBIOTIC WORLD

Teachers: Silvana Munzi (Univ. Lisboa), Cristina Cruz (Univ. Lisboa), Lourdes Morillas (Univ. Lisboa).

Note: This course will be provided online.

Calendar: February 8th-12th 2021

Schedule: 9:00-13:00 (20h)

Objectives: Symbiosis is a key strategy for life on Earth. Nevertheless, although many research groups have long been committed to the study of symbiosis, its definition and functioning are not fully understood, and its ecological role and relevance are still underestimated.

Symbiotic associations vary from parasitism to mutualism and even simple persistent biological interactions, making the knowledge fragmented and focused on the details of single symbiotic systems. Knowledge of the various symbiotic relationships is rapidly increasing with the development of -omics tools, but without efforts to find common grounds. The concept itself of symbiosis can be faced by different points of view, spanning from biology to evolution, from philosophy to artificial intelligence.

In this course, we promote a multidisciplinary approach presenting the most recent findings on the topic and challenging the traditional way of considering symbiotic associations as exceptions and not as the rule.

General plan: Starting from the definition of symbiosis, we'll analyze the role of symbioses in evolutionary terms. Plant-fungal-bacteria symbioses will be presented to illustrate ecological networks and ecosystem services. Examples of different symbiotic associations (lichens, biofilm, mycorrhizas) will be given by specialists in the field in theoretical-practical lessons taking in consideration morphological, physiological and ecological aspects. Part of the course will be

devoted to the human microbiome and insect-bacteria symbioses and their consequences on/potentialities for human and environmental health. Philosophical aspects and challenges brought by the new discoveries in the area will be discussed. Potential applications in technology like evolutionary algorithms and industrial symbiosis will be considered as well as sociological aspects associated to agroecology.

Final program

	Monday 8 February	Tuesday 9 February	Wednesday 10 February	Thursday 11 February	Friday 12 February
09:00-10:00	Eukaryote evolution ¹	<i>Rhizobium</i> ⁵	Human Microbiome ⁹	Biological individuality ¹³	Agroecology ¹⁷
10:00-11:00	Mutualism - parasitism continuum ²	Plant microbiome ⁶	Lichen symbionts ¹⁰	<i>Wolbachia</i> ¹⁴	Artificial Intelligence ¹⁸
11:00-11:30	Coffee-break	Coffee-break	Coffee-break	Coffee-break	Coffee-break
11:30-12:30	Arbuscular mycorrhizas ³	Trophic interactions ⁷	Metagenomic data analysis ¹¹	Microbial biofilms ¹⁵	Wikipedia ¹⁹ practical exercise
12:30-13:30	Corals ⁴	Insect symbioses ⁸	Anthropogenic changes and symbiosis ¹²	Communication ¹⁶	

¹ Eukaryogenesis in 3D – or is it 2D? - *Ricardo Melo*, University of Lisbon (Portugal).

² The symbiotic continuum: a borderless world - *Ana Corrêa*, University of Lisbon (Portugal).

³ Arbuscular mycorrhizas: modern approaches to an ancient symbiosis - *Andrea Genre*, University of Turin (Italy).

⁴ Cnidarian-dinoflagellate symbioses: Foundations of coral reef ecosystems and imperiled by climate change - *Virginia Weis*, Oregon State University (USA).

⁵ Root Nodule Bacteria/Nitrogen Fixing Bacteria - *Isabel Videira e Castro*, National Institute for Agricultural and Veterinary Research (Portugal).

⁶ The hidden microbial world of plants – *Pablo Carril Vaglini*, University of Lisbon (Portugal).

⁷ Soil biodiversity: (beyond) symbiosis - *Stefan Geisen*, Wageningen University and Research (Netherlands).

⁸ Insect symbioses - *Martin Kaltenpoth*, Johannes Gutenberg University of Mainz (Germany).

⁹ The human oral microbiome in health and disease - *Nuno Taveira*, University of Lisbon (Portugal).

¹⁰ Who does what? How to study the different symbionts in a lichen symbiotic association - *Silvana Munzi*, University of Lisbon (Portugal).

¹¹ Application of artificial intelligence in study of environmental impacts on symbiotic systems - *Manju Gupta*, University of Delhi (India).

¹² Anthropogenic changes and symbiosis - *Erik Olm*, University of Mississippi (USA).

¹³ Symbiotic biosystems and the question of organismality - *Davide Vecchi*, University of Lisbon (Portugal).

¹⁴ *Wolbachia* - *Luis Teixeira*, Instituto Gulbenkian de Ciência (Portugal)

¹⁵ Microbial biofilms - *Juliana Melo* and *Cristina Cruz*, University of Lisbon (Portugal).

¹⁶ Symbiosis and Communication - *Maria Amélia Martins-Loução* and *Cristina Cruz*, University of Lisbon (Portugal).

¹⁷ Agroecology: symbiotic processes applied to agricultural production systems - *David Avelar*, University of Lisbon (Portugal).

¹⁸ Symbiosis in Artificial Intelligence - *Luís Correia*, University of Lisbon (Portugal).

¹⁹ Wikipedia, a “symbiotic project” - *Silvana Munzi* and *Lourdes Morillas*, University of Lisbon (Portugal).

This course can have recognition of 3 ECTS for FCUL PhD students enrolling in it as part of their first doctoral year.

Nº (min, max) students: 10 – 15

Minimum formation: Bachelor (“Licenciatura”) in Biology, Natural Science or related areas

Directed to: PhD or MSc students in Biology, Microbiology, Ecology, Environmental Studies or related areas, and postdocs and other professionals working in related topics

Fee: free for 1st year PhD students in Doctoral programmes at FCUL (e.g. Biologia), Biodiversity, Genetics and Evolution (BIODIV UL; UP) and Biology and Ecology of Global Changes (BEAG UL, UA) when the course counts credits for their formation, in which case the delivery of a final report done after the course is mandatory; the course is also free for more advanced PhD students of the BIODIV programme (ULisboa or UPorto); 15 € for other PhD students from cE3c, 30 € for PhD students from institutions of the PEERS network (CFE); 55 € for FCUL Master students, more advanced PhD FCUL students and unemployed; 80 € for BTI, BI and other PhD students; 115 € for Professional and postdocs.

When the maximum number of students is reached 8 vacancies will be available for non-paying 1st year PhD students mentioned above, being, by order of preference: 1) cE3c students; 2) BIODIV students (not from cE3c); 3) FCUL students (not from cE3c); 4) BEAG students (not from FCUL).

Deadline for applications: December 28th, 2020

Candidates should send an e-mail to Silvana Munzi (ssmunzi@fc.ul.pt) with a short cv and motivation letter. The cv and letter should be named as *1st-lastNAME-CV.pdf* and *1st-lastNAME-ML.pdf* (that is personalize the name of each file with your first and last name).

In the email please add the following information:

Full Name:

E-mail:

Phone:

Professional activity: Professional/Postdoc, BTI, BI (or other non-post-doc research grant), PhD student (with/without scholarship), Lic. (Bachelor)/Master student

PhD student of the 1st year of a Doctoral programme at FCUL, BIODIV (FCUL/FCUP), or BEAG (FCUL or UA)?

If yes to the above question, PhD student doing the Course to count credits for 1st year?:

PhD student of cE3c or CEF (Centro de Ecologia Funcional)?:

Name of the PhD programme: