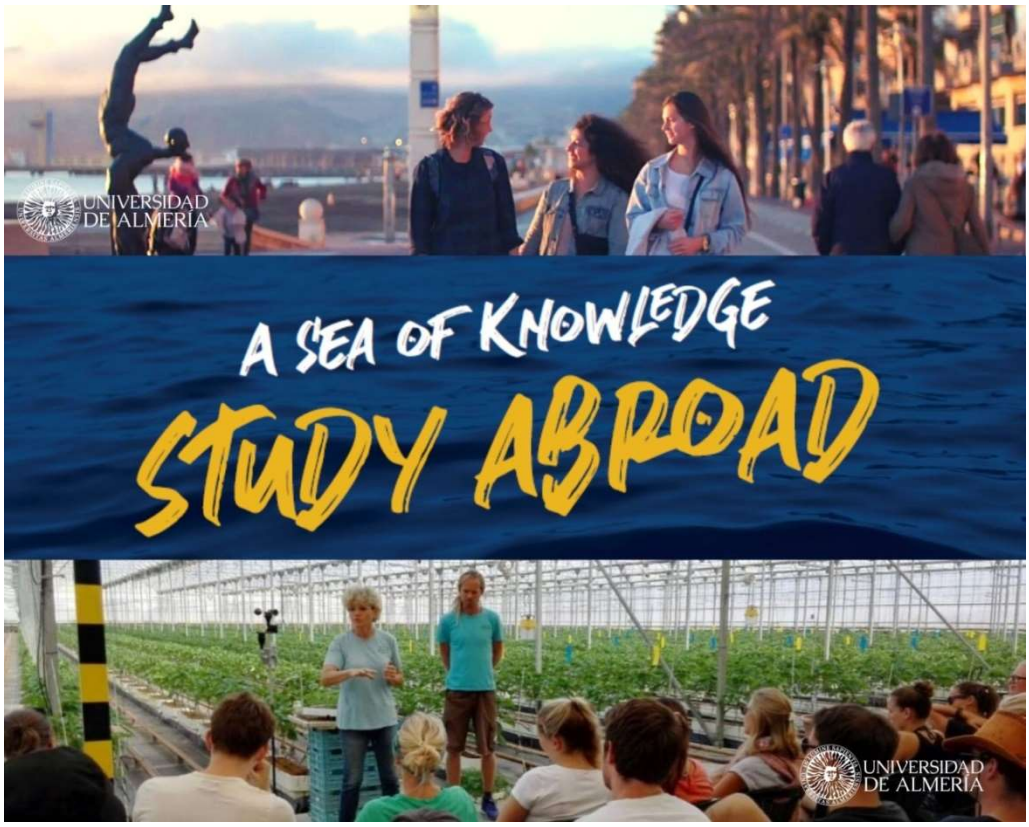

[ECO-FRIENDLY POTENTIAL OF ENVIRONMENTAL MICROORGANISMS: BIOREMEDIATION AND BIORECOVERY]

Dates: July 7th – July 25th 2025

Teaching hours: 60 hours

Area of knowledge:
Microbiology/Biotechnology/Environmental Science

Academic coordinator: Macarena Jurado Rodríguez and Juan Antonio López González

INTRODUCTION

The level of development reached by society during the so-called "Anthropocene era" has brought, in parallel to the multiple benefits, an unprecedented level of ecosystem destruction. In this sense, the science and technology that led to these advances must now also provide the tools to stop and/or control this "ecocide" derived mainly from the misuse of natural resources by human beings. This situation is seriously compromising the maintenance of life in an increasingly shorter term, so the time for action is urgent.

The branch of knowledge that deals directly with proposing (and carrying out) solutions that minimize or eliminate environmental pollution corresponds to Environmental Biotechnology. In addition, the knowledge generated in this field allows the treatment of waste (especially those of anthropogenic origin); the use of alternative and more respectful industrial processes having no or minimum generation of waste ("zero waste"); as well as, the use of waste as raw materials, and the replacement of non-renewable resources by renewable ones. All this knowledge is based on a deep respect for the biogeochemical cycles of the elements and on criteria of environmental sustainability. For this, the leading role is played by the microorganisms and their products.

MAIN GOALS

1. To study and assimilate concepts related to Environmental Biotechnology: biogeochemical cycles, environmental pollution, environmental microorganisms.
2. To study the different processes available for the bioremediation of polluted habitats and the biodegradation of polluting compounds.
3. To study the biotechnological alternatives available for the treatment of waste and to replace current materials and processes that aggressive to the environment

CONTENT

Course Modules	Description
MODULE A: Introduction to Environmental Biotechnology	*Understanding the problem of environmental pollution and the importance of biotechnological applications.* • Introduction to Environmental Microbiology and Biotechnology. • Study of the environmental microorganisms involved in the biogeochemical cycles. • Impact of anthropogenic activity on the environment: bioindicators.
MODULE B: Bioremediation processes	*Study of biodegrading microorganisms and other living organisms with potential as tools for the bioremediation of polluted environments.* • Introduction to Bioremediation: Basic concepts and fundamentals.

	• Bioremediation strategies *in situ* and *ex situ.* • Bioremediation of recalcitrant pollutants.
MODULE C: Obtaining of bio-based products	*Knowledge of biological processes and the technology used in the use of organic waste to obtain different bio-based products and by products.* • Introduction to Biorecovery: Basic concepts and fundamentals. • Strategies for the use of by-products and waste recovery.
MODULE D: Biorefineries: from waste to resources	*Study of industrial cascade processes using waste as potential resources to obtain bioproducts: a paradigm shift based on the circular economy.* • Introduction to Biorefineries: Basic concepts and fundamentals. • Case study: cascade harnessing

COURSE METHODOLOGY	
In-lab sessions ☒	Company visits ☒
Academic visits ☒	Talks ☒
Lectures ☒	Others ☐
All the thematic lines described in the previous section, will be carried out from a practical point of view. Each session will consist of an explanation with a theoretical basis, necessary for the understanding of the contents, after which a series of practical procedures related to the subject taught will be applied. Taking into account the possible different profiles of the students, the first session will consist of a general approach about the peculiarities of working in a microbiology laboratory: work in aseptic conditions, sterilization and disinfection techniques, preparation of culture media, techniques of pure cultivation, etc. The rest of the work of that first week would try to characterize the autochthonous microorganisms from a specific environment, making tests that relate them to the cycles of the fundamental elements (C, S, P and N) as well as the role of bioindicator organisms. During the next module, the ability of microorganisms to decontaminate environments will be studied through culture techniques based on the enzymatic and functional profile. At the same time, the potential of environmental microorganisms to valorize waste will be studied, and exemplified on a large scale with practical-theoretical seminars and visits to companies in the sector	

REQUIREMENTS
B2 English language level recomended

ACADEMIC VISITS & NETWORKING

There will be two visits related to the topics taught in the course. Firstly, a visit to explore the economic importance of the agricultural sector in the province (IFAPA). Secondly, a visit to a biotech-based company (KIMITEC), transversally related to the whole course and more specifically to Module C. Likewise, two talks will be held by experts related to the aforementioned business sectors.

ASSESSMENT

At the end of the course, students will summarize their work including the results obtained in the laboratory, with the advice of the teaching staff, so they will acquire the capacity to interpret and discuss results based on the scientific bibliography related to the studied topics. To pass the course, at least 80% of attendance is required.

LECTURERS

Macarena del Mar Jurado Rodríguez

She is **Associate Professor**, with a PhD in Biotechnology and Bioprocesses (2015), and an Agronomy Engineering Degree (2012). She is a member of the BIO-175 Group of the University of Almería (UAL) since 2010, with which she has participated as a contracted staff in charge of more than 12 research projects, of national and European foundation. She teaches different subjects of the Microbiology Area of the UAL related to Biotechnology Degree and Master, Environmental Science Degree, and Bioeconomy and Sustainability Master. She has participated as author and co-author in 43 scientific articles, published in international impact journals, as well as in more than 80 communications to national and international congresses. She also has participated in several scientific divulgation activities such as Pint of Science or Researcher´s Night.

Juan Antonio López González

He holds a Ph.D. in Agricultural Engineering from the University of Almeria with a Master in Research in Treatment, Management and Valorization of Organic Waste at the Miguel Hernández University. He is currently a **Associate Professor** of Microbiology at the University of Almería. He has participated in twelve research projects, such as contracted research staff, interns or postdoctoral researcher. The forty-two articles in which he has worked as an author or co-author have been published in prestigious international journals. The presentation of almost a hundred communications to congresses, fifteen of them of an international nature, deserves a special mention.

María José López López

She is **Full Professor** of Microbiology at the University of Almeria since 2002, with teaching in many subjects related to Microbiology to both undergraduate and postgraduate students. She is the author of two books and almost 70 articles published in international journals. She has directed more than 30 final degree projects and 4 Doctoral Theses. Principal Investigator of 3 national research projects, 3 European and 1 with the United States. She is a member of the Spanish Composting Network (REC).

Francisca Suárez Estrella

She teaches at the University of Almeria (UAL) since 1998. PhD in Biology since 2001 and currently hired under the title of **Full Professor** in the area of Microbiology at UAL. Her research activity within the BIO-175 Group focuses on the study of microorganisms isolated from composting processes with agricultural applications such as biopesticides and biostimulants. She has co-authored 40 scientific articles of international journals, 11 chapters of scientific books and 2 patents. She has co-directed various research projects and contracts, and 3 Doctoral Theses, one of which is still in the implementation phase.

María José Estrella González

She is **Assistant Professor** with a PhD in Biochemistry since october of 2020. In the last three years, she had been links to the BIO-175 Group of the University of Almería (UAL). She teaches classes in different subjects of the Microbiology Area of the UAL. She has participated as author and co-author in 6 scientific articles, published in international impact journals, as well as in some 15 communications to national and international congresses. In addition, she has organized scientific dissemination events such as Pint of Science and scientific dissemination activities associated with the projects of the research group.

María Rosa Martínez Gallardo

She is **Assistant Professor** with a PhD in Biotechnology and Industrial Bioprocess since 2021 and with links to the BIO-175 Group of the University of Almería (UAL) since 2019, with which she has participated as a contracted staff in charge of three international research projects financed with European funds. She teaches at the Microbiology Area of the UAL. She has participated as author and co-author in 12 scientific articles, published in international impact journals, as well as in some 20 communications to national and international congresses.

Ana Josefa Toribio Gallardo

She is **Substitute Instructor** with a PhD in Biochemistry since 2021. She was awarded a pre-doctoral scholarship to train research staff of the Ministry in the Department of Applied Biology, Area of Genetics, where she obtained the Diploma of Advanced Studies (D.E.A.) in the field of Biotechnology and taught as a trainee teacher during that period. Hired by companies in the Almerian agro-food sector Savia Biotech S.A. and Coexphal as research staff participating in I+D projects for the development of Molecular Diagnostic Methods and control of microbial rot during post-harvest handling, in the Department of Plant Pathology and Microbiology. Since 2018, she has been linked to the BIO-175 Group of the University of Almeria (UAL), with which she has participated as contract personnel in two

research projects and is currently working in the research line; Antagonism and suppression of phytopathogenic microorganisms, especially focused on the search for biological control agents from natural substrates.

Jesús Salinas Nieto

He (**Predoctoral Researcher**) is an environmental sciences graduate, currently PhD student in Biotechnology and Industrial Bioprocesses Applied to Agri-Food and Environment, linked to the BIO-175 Group of the University of Almería (UAL) since 2014 as student and researcher. At this moment, he is working on RECOVER project discovering new biotechnological strategies for the biodegradation of conventional plastics by utilization of microbial consortia. He has recently begun his journey co-tutoring of final thesis of the biotechnology degree program and has presented several communications at both national and international congresses. He also has participated in several scientific divulgation activities such as Researcher's Night and Science Week.

Rosario Lerma Moliz

She (**Predoctoral Researcher**) is a biotechnologist with a master's degree in Advanced Therapies and Biotechnological Innovation. She started working in the BIO-175 research group, Microbiology area, at the University of Almeria in 2018, and is currently doing her PhD in Microbiology in this same group. In addition, she works as a laboratory manager in the company Microbius Biotech S.L. She has several communications to national scientific congresses and one at international level. She has also participated in scientific dissemination activities such as the European Researchers' Night.

Víctor Carpena Istán

He (**Predoctoral Researcher**) completed his bachelor's degree in Biotechnology (2015-2019) followed by a master's degree in Industrial and Agri-food Biotechnology (2020-2021) by the University of Almeria. Circular economy, residues revalorization, and biotechnological approaches for transitioning to a more sustainable world became his obsession and his life's purpose. Throughout the years, he has been guided by the passionate team of researchers of the microbiology department (BIO-175 research group) where he decided to enroll in the Biotechnology PhD program. He is currently developing his thesis under the European project "Recover" whose main aim is to solve the end-of-life challenges of agri-food plastic residues by utilizing bacterial consortium as well as insect and earthworms to accelerate plastic biodegradation. Moreover, he has participated in several scientific dissemination activities such as the European researcher's night and The Science Week.

Raúl Jiménez Rodríguez

He (**Predoctoral Researcher**) is a biochemist with a Master's degree in Agri-Food Biotechnology. He started working in the BIO-175 research group, area of microbiology, in 2021. In addition, he is currently conducting his PhD studies in this research group in the area of agrobiotechnology, investigating the use of aqueous compost extracts in the control of plant crop diseases. Recently, he has also began to co-tutoring of final thesis of the

biotechnology degree program, as well as presenting comunications at both national and international congresses. He has also participated in several scientific divulgation activities.

Martin Segado Ruiz

He (**Predoctoral Researcher**) is a biotechnologist with a master's degree in Biotechnology and Industrial Bioprocesses Applied to Agri-Food and Environment. Currently, he is PhD student, linked to the BIO-175 Group of the University of Almería (UAL) since 2020, at the beginning as student and recently as researcher. At this moment, he is working on RECOVER project as the baseline for new biotechnological strategies for the biodegradation of conventional plastics by utilization of microbial consortia. Moreover, he has several communications to national scientific congresses and he also has participated in several scientific dissemination activities such as Researcher´s Night and Science Week.

Daniel Lorente Escánez

He (**Predoctoral Researcher**) is a biotechnologist with a bachelor's and master's degree, currently working as a PhD student within the BIO-175 research group. He is involved in research into promoting plant welfare and soil health through the application of compost-derived pro- and prebiotics. In addition, he participates in the co-direction of final degree projects for the Biotechnology Degree at the University of Almería, as well as actively participating in the scientific dissemination activities of the research group.

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