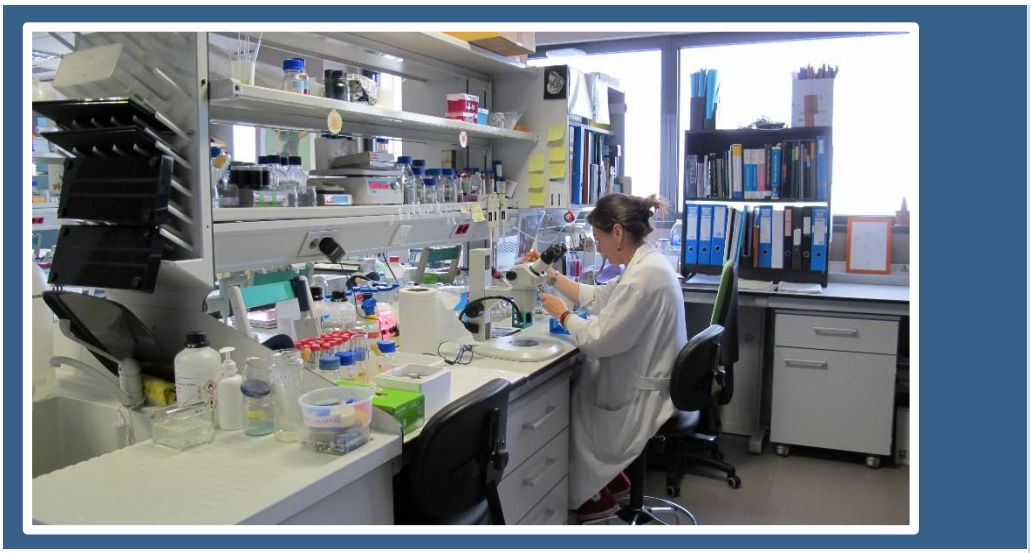
UC Summer Programs 2016

<< Research in Biotechnology >>



RESEARCH, EXPLORE AND LEARN

A REAL Summer Abroad Experience at the University of Cantabria (Spain)

Institute of Biomedicine and Biotechnology of Cantabria

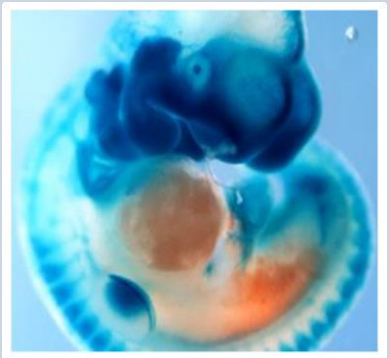
The Institute of Biomedicine and Biotechnology of Cantabria (IBBTEC) is a joint Centre belonging to the University of Cantabria, the National Research Council (CSIC), and the Regional Government. Its main aim is to carry out high-quality scientific research in biological disciplines, both in basic and applied aspects, with the aim of advancing in scientific knowledge and as well as the transfer of technology in order to potentiate the productive sectors related to Health and Biotechnology applications.

The IBBTEC

- *6.175 m^2 of modern facilities*
- *23 well-equipped research Labs*
- *13 Research Group*
- *More than 80 investigators*

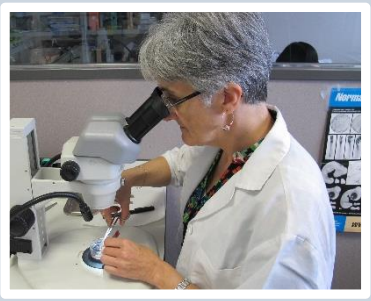
The Biotechnology Abroad Program

Program aimed at teaching undergraduate students the basics of biotechnological research and applications. Contents include fundamentals of modern molecular biology and genome structure, genetic engineering techniques and advanced technology of genomic-level gene analysis in Biomedicine, or biotechnological procedures for animal manipulation and for production of biological molecules of industrial interest. Additionally, several leaders of IBBTEC research groups will introduce the students to the scientific method and present their research fields and teams, which will host the students for the research practice.



Courses included:

- *Fundamentals of Molecular Biology and Genetic Engineering*
- *Biotechnology in Medicine*
- *Industrial Biotechnology*
- *Research in biotechnology: a case-based*



Biotechnology fundamentals COURSE compulsory

WEEK 1: FROM MOLECULAR TO SYNTHETIC BIOLOGY

[30 May - 2 June 2016]

MONDAY [10h -13h]

10:00 Guided visit to the IBBTEC

10:30 Introduction to Molecular Biology and Genetic Engineering

Brief History of Molecular Biology. Gene-cloning strategies (from the classical cut-and-join to synthetic DNA constructs). Historical applications of Genetic engineering. site-directed mutagenesis, protein engineering, different types of PCR, old and new sequencing techniques (from short stretches of DNA to whole genomes), etc.

Fernando de la Cruz, Full Professor UC

11:45 How to write a scientific paper

Fernando de la Cruz, Full Professor UC

TUESDAY [10h -13h]

10:00 Genome structure in bacteria: Modified microorganisms for biotechnological purposes

Genomic plasticity: plasmids & gene transfer. Genetic modification: exploiting the potential of bacteria. Regulation of gene expression. Synthesis of commercial products by recombinant microorganisms. Bacteria as bioreactors. Metabolic engineering in bacteria.

Mapi Garcillan, Senior Research Associate

11:30 Practical session. In silico genetic analysis. Blast. Sequence aligments

Mapi Garcillan, Senior Research Associate

WEDNESDAY [10h - 13h]

10:00 Synthetic biology

Design and construction of biological devices and systems. Microfabrication of miniature structures to be used in microfluidics devices. Systems biology: study of complex interactions in biological systems. Computer modelling of biological systems. Minimal genomes.

Raul Fernandez-Lopez, Senior Research Associate

11:30 Synthetic biology in the lab. Microfabrication

THURSDAY [10h - 13h]

10:00 Biomedical and biotechnological applications of yeasts.

Eukaryotic cell cycle. Yeast as a model.

11:15 Practical session

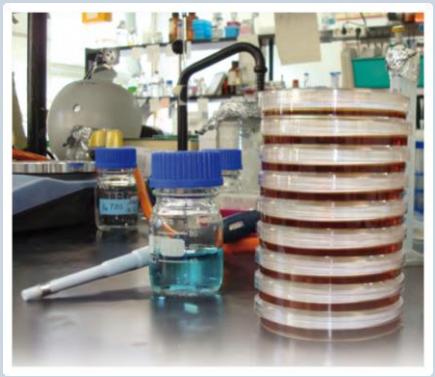
How to brew beer. Making beer in the lab.

Alberto Sanchez, Ramón y Cajal Research Associate and Gabriel Moncalian, AssociateProfessor UC

Biotechnology fundamentals COURSE compulsory

WEEK 2: BIOMEDICAL AND BIOTECHNOLOGICAL METHODS

[6 -9 June 2016]



MONDAY [10h -13h]

10:00 Structural Biology

Three dimensional protein structure. Electron microscopy, MNR, Protein Crystallization, SAXS.

Iñaki Arechaga, AssociateProfessor UC

11:30 Crystallization of lysozyme I

Protein crystals will be obtained by the students out of a lysozyme concentrated solution.

Elena Cabezón, AssociateProfessor UC and Gabriel Moncalián, AssociateProfessor UC

TUESDAY [10h -13h] at UC-Medical School

10:00 Transgenic animals

Strategies for gene transfer to animals. Advanced technology, which does not require the direct modification of the target gene (Antisense RNA, RNA interference, intracellular antibodies, etc…).

Ramón Merino, Staff Scientist CSIC

11:30 Transgenic animal manipulation.

Working in an animal facility. Guided visit to the animal facility at the UC Medical School.

WEDNESDAY [10h - 13h]

10:00 Stem cells and regenerative medicine

Embryonic and tissue stem cells. Stem cells-based therapies. Induced pluripotency in somatic cells

Javier León, Full Professor UC

11.30 How to work in a cell culture lab: Growing stem cells

Differences between stem cells and other cellular lines under the microscope.

Javier León, Full Professor UC

THURSDAY [10h - 13h]

10:00 Gene therapy approaches

Technology for genetic modification of specific cellular types. Gene therapy in practice: struggles and successes. Future prospects.

Matxalen Llosa, AssociateProfessor UC

11.30 Designing a gene therapy research project

Practical work (in pairs): computer search for several genetic conditions and analysis of its suitability for a gene therapy approach. Experimental design of a gene therapy research

WEEK 3: THE INFORMATION WITHIN THE DNA

[13 -16 June 2016]

MONDAY [10h -13h]

10:00 Organization of the human genome.

General organization: nuclear and mitochondrial genomes. Coding and noncoding DNA: protein-coding genes, RNA genes, pseudogenes, highly repetitive DNA. Comparative genomics and genome evolution. Human gene expression

Ignacio Varela, Ramón y Cajal Research Associate

11:30 Debate: Social and cultural issues around genomics

Protein crystals will be obtained by the students out of a lysozyme concentrated solution.

Ignacio Varela, Ramón y Cajal Research Associate and Fernando Salmon, Full Professor UC

TUESDAY [10h -13h] at UC-Medical School

10:00 Developmental Biology

The developing limb. A paradigm for developmental biology studies. Molecular regulation of apical ectodermal ridge formation

Marian Ros, Full Professor CSIC

WEDNESDAY [10h - 13h]

10:00 Diagnostic molecular methods in infectious diseases

Application of molecular techniques in the diagnosis of infectious diseases. Practical case: From bench to bed.

The drawbacks of antibiotic usage. Antibiotic

12.00 Practical session.

Microbial identification in the Lab. Gram assay. Microscopy, Malditof. 16s sequencing. Directigen.

Juan M Garcia-Lobo, Full Professor UC and Felix Sangari, Tenured Scientist UC

THURSDAY [10h - 13h]

10:00 Visit to the Spanish Institute of Oceanography (IEO).

WEEK 4: BIOTECHNOLOGY IN FOOD AND MEDICINE

[20 -23 June 2016]

MONDAY [10h -13h]

10:00 Protein engineering

DNA mutagenesis methods. Protein engineering: improvement of the properties of industrial enzymes. Rational design based on three dimensional structures. Directed evolution to evolve proteins or nucleic acids. Improvement of certain bacteria and fungi by metabolic engineering. Examples of successful approaches.

Gabriel Moncalián, AssociateProfessor UC

Asignment 1. Synthetic biology for biotechnological applications.

11:30 Crystallization of lysozyme II.

Lysozyme crystals will be observed and harvested under the microscope. Computational process for structure determination. Protein structure visualization programs. How to use pymol.

Elena Cabezón, AssociateProfessor UC and Gabriel Moncalián, AssociateProfessor UC

TUESDAY [10h -13h]

10:00 Diagnostic molecular methods in oncology

Molecular Bases of Cancer: hallmarks of cancer, oncogenes and tumor suppressor genes. Molecular Diagnosis of Cancer: identification of chromosomal translocations, gene amplification and mutation. New tools for molecular diagnosis by genome-wide approaches. Targeted therapy in cancer.

Piero Crespo, Full Professor CSIC and M Dolores Delgado, Full Professor UC

WEDNESDAY [10h - 13h]

10:00 Neuropsychopharmacology

Neuronal communication. Biological basis of depression: new targets for developing antidepressants. β-catenin and depression.

Angel Pazos, Full Professor UC

11:30 Neuropsychopharmacology in the lab

Juán López, Staff Scientist CSIC

THURSDAY [10h - 14h]

10:00 The chemical and biochemical basis of cheese

Rennet composition. Casein coagulation. cheese nutrition facts.

11:15 Practical cheesemaking

13:00 Sampling of Cantabrian cheeses

Arroyo laboratories

FRIDAY [10h - 13h]

10:00 Visit to Dougall´s Brewery (Lierganes)

ASSIGNMENTS

Individual assignments:

Writing a semi-scientific article:

Each student will write a 5 pages article with introduction, materials and methods, results, discussion and references according to the instructions provided in the first class. Suggested subjects are molecular cloning, reproductive cloning, therapeutic cloning, gene therapy, protein engineering, PCR, DNA sequencing, transgenic animals. The due date will be on Monday the third week 11:00 am. The article will be reviewed in a peer-review journal format by different researchers of the IBBTEC and will be sent back to the students for final corrections. The corrected articles will be discussed with the rest of the class.

Class presentations:

Synthetic biology for biotechnological applications.

Each student will think during the previous day about a synthetic biology system they would like to design for any purpose. After some research over the internet to consolidate their idea, each student will give a presentation using the blackboard (5 minutes each) followed by a short brainstorm with the rest of the students. (Due day June 20th).

Debate assignment: Social and cultural issues around genomics. Gene therapy. Pros and cons of transgenic animals. The different arguments will be debated with the professors.

Other assignments: review of scientific paper. Scientific papers for discussion could be provided.

BIBLIOGRAPHY

- *Molecular Biotechnology: Principles and applications of recombinant DNA. Glick & Pasternak. 4th edition. (2010)*
- *Molecular Genetics of bacteria . Snyder & Champness. 3rd edition. (2007)*
- *Principles of gene manipulation and genomics. Primrose & Twyma . 7th edition. (2006)*
- *Human Molecular Genetics. Strachan & Read. 4th edition. (2010)*
- *The Cell. A molecular Approach. Cooper and Hausman. 5th edition. (2010)*
- *Molecular Cell Biology . Lodish et al. 6 th edition (2008)*
- *Lewin's Genes X. Krebs, Goldstein, Kilpatrick. (2011)*
- *Synthetic Biology: Industrial and Environmental Applications. Schmidt, M. 3rd edition.(2012).*
- *Biotechnology. Smith, J.E. 5th edition (2009).*

A CD with the presentations shown by the speakers will be provided to the students after course completion.

IBBTEC

PCTCAN

Cl. Albert Einstein, 22

39011 Santander

Phone :

+34 942 206799 ext. 117

Email:

ibbtec@unican.es

Web site:

web.unican.es/ibbtec

A REAL

summer abroad experience

RESEARCH PRACTICES

During weeks 5 to 8, students will join a research team of the Institute leading the selected program. The research work will depend on the host research group and the selected activity. A maximum of two students will be allocated to a single research team. The number of places and research teams will be offered to the students at the start of the program. Students will apply for their preferred options. If more than two students choose the same team, the research team leader will select two students based on their Resume and a personal interview.

IBBTEC is a joint research centre belonging to:

MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

CSIC Consejo Superior de Investigaciones Científicas

GRUPO SODERCAN sociedad para el desarrollo regional de cantabria

UC UNIVERSIDAD DE CANTABRIA