The revolution of stem cell research (AB000001)

1. language

English

2. course contents

Coordinator: Prof. Parolini Ornella
Year Course: 1° year
Semester: 1° semester
UFC: 10
Modules and lecturers:
- CELLULAR SECRETOME: COMPONENTS AND PROPERTIES (AB000020) - 2 UFC - SSD BIO/13
Prof. Papait Andrea
- CELLULAR SECRETOME: COMPONENTS AND PROPERTIES LAB (AB000021) - 1 UFC - SSD BIO/13
Proff. Chiodelli Paola, Romele Pietro, Pasotti Anna
- STEM CELL BIOLOGY (AB000017) - 2 UFC - SSD BIO/13
Prof. Parolini Ornella
- STEM CELL BIOLOGY LAB (AB000019) - 1 UFC - SSD BIO/13
Proff. Chiodelli Paola, Romele Pietro, De Munari Silvia
- STEM CELL RESEARCH: AN ANTROPOLOGICAL QUESTION (AB000023) - 2 UFC - SSD MED/43
Prof. Mantini Alessandro
- TISSUE REGENERATION DURING EVOLUTION: FROM INVERTEBRATES TO VERTEBRATES (AB000022) - 2 UFC - SSD BIO/13
Prof. Papait Andrea

3. BIBLIOGRAPHY

Stem Cell Biology

The following textbooks may be used for consultation on basic topics:
- Cellule staminali. G.P. Bagnara, L. Bonsi e F. Alviano. Seconda edizione – 2017. Ed. Esculapio.
- Stem cells: an insider's guide. P. Knoepfler. 1st edition – 2013. Ed. World Scientific.
- Essentials of Stem Cell Biology. R. Lanza, A. Atala. 3rd edition – 2013. Ed. Academic Press.
- The Science of Stem Cells. J.M.W. Slack. Ed. 2018 Wiley

Stem Cell Biology Lab

Updated scientific articles, journals, and protocols will be provided to students during the course.

Cellular Secretome: Components And Properties

Updated scientific articles and journals will be provided to students during the course.

Cellular Secretome: Components And Properties Lab

Updated scientific articles, journals, and protocols will be provided to students during the course.

Stem Cell Research: An Anthropological Question

Updated scientific articles, journals and slides will be provided to students during the course

Tissue Regeneration During Evolution: From Invertebrates To Vertebrates

Updated scientific articles and journals will be provided to students during the course.

Where necessary, students will be provided with supplementary teaching materials, in the form of articles, journals and protocols updated during the course, as well as the indication of appropriate and reliable telematic sources, to supplement, deepen and update the content explained in class.

4. LEARNING OBJECTIVES

The integrated course aims to provide students an overview of stem cell research both from a practical and a theoretical point of view. The key concepts of stem cell biology and their isolation, characterization and functional profile for therapeutic purposes will be introduced, with particular attention to their paracrine activity through a focus on the composition and properties of their secretome. The course also includes topics on both the evolutionary aspects of the regenerative abilities of stem cells and the ethical, legal, and social implications that stem cell research has raised over the years.

Upon completion of the integrated course, the student must demonstrate that he or she has acquired the following objectives:

Knowledge and understanding the key principles of the biological mechanisms that govern stem cells, with particular reference to their characterization, their implication in histomorphogenesis and homeostasis of human organs and tissues, and understanding the basis of their therapeutic potential. Practical activities will provide knowledge about the main sources and methods for the isolation and *in vitro* characterization of stem cells with a focus on their secreted factors. Furthermore, through the integrated approach, the course aims to provide a critical view of the possibilities and issues that stem cell studies may entail.

Applying knowledge an understanding how to adequately interpret and understand the applicative aspects of stem cells highlighting their translational potential in applications of regenerative medicine; the role of all secreted factors in the performance of therapeutic functions, as well as a complete understanding of the principles of regeneration to develop regenerative therapies considering the possible ethical limitations. Learn laboratory techniques that could be used in stem cell research.

Making judgements - Critically review published research in stem cell biology and regenerative medicine, identify and discuss current controversies about stem cells and regenerative medicine in published research, formulate relevant problems around worthwhile clinical interventions in regenerative medicine, acquire critical and design skills in order to independently carry out observations and experiments, based on the laboratory activities learned.

Communication skills - Know how to communicate clearly and unambiguously, using technical language, in order to appropriately disseminate the scientific contents inherent to stem cells research as well as the potential and criticalities related to them. The student will also develop the ability to work in groups and clearly communicate their knowledge and research results to specialist and non-specialist interlocutors.

Learning skills - The student must be able to demonstrate a good capacity of self-assessment, to update and expand his/her knowledge through scientific articles and online platforms (NCBI, ATCC, Human cell atlas etc.), acquiring the ability to attend specialized seminars, conferences, masters etc.

5. prerequisitES

Students must have previously acquired knowledge related to the basic disciplines provided in the three-year degree courses preparatory to this degree class, with particular reference to: Cellular/Molecular experimental Biology, Genetics and Histology.

6. TEACHING METHODS

The teaching methodology is based on face-to-face lectures and when scheduled, experimental activity/laboratory exercises. Teaching is based on interactive modes marked by active learning, such as: "problem-based learning," "self-learning," and "case studies."
The teaching methods used in this course are designed to enable the student to pursue the learning objectives, by virtue of the following characteristics:

Knowledge and understanding - Frontal teaching and laboratory activities will systematically cover all the topics listed in the program detailed below, dwelling on the most relevant and indispensable aspects, so as to provide students with the complete picture of the integrated topics and the correct study method to reinforce theoretical knowledge.

Applying knowledge and understanding - The use of practical examples, classroom exercises and "case studies" will enable students to learn the application potential of the topics covered, while practical laboratory exercises will allow the students to learn the applications of the different methodologies, with particular emphasis in protocol design and discussion of the different techniques.

Making judgements - The active learning methods implemented in this course are designed to allow the student the ability to independently design an experiment and formulate innovative concepts/ideas.

Communication skills - Active learning methods and constant interaction with the instructor during lectures and laboratory sessions will be conducted in a manner that will allow the student the progressive acquisition of communication skills aimed at the exposition of main stem cells research topics/protocols with the correct scientific terminology.

Learning skills - The use of supplementary teaching materials, including in the form of articles from the international scientific literature, will enable the student to continue to study mostly self-directed or independently.

7. OTHER INFORMATIONS

Lecturers are available for reception by appointment after contacting them by email:

Ornella Parolini: ornella.parolini@unicatt.it
Andrea Papait: andrea.papait@unicatt.it
Paola Chiodelli: paola.chiodelli@unicatt.it
Alessandro Mantini: alessandro.mantini@unicatt.it

Lecturers may send communications to the class via email and/or via the BlackBoard platform.

NOTE ON STUDENTS' RESPONSIBILITY

The responsibility for learning falls increasingly on students, as they advance through the course; hence, ultimately, the commitment and the dedication to learn must come from them.

As members of the Università Cattolica S. Cuore learning community, students are expected to respect the intellectual property of course instructors. All course materials presented to students are the copyrighted property of the course instructors and are subject to the following conditions of use:

1) Students may not record nor reproduce lectures or any other classroom activities, unless differently specified by the instructor; however, they may use the recordings for their own course-related purposes only.

2) Students may not reproduce and/or post any course material provided by the instructors online or distribute them without the advance written permission of the course instructor and, if applicable, of any students whose voice or image is included in the recordings.

3) Any students violating the conditions described above may face academic disciplinary sanctions. As members of a learning community, students are expected to respect the time and efforts of their fellow classmates. Therefore, the use of social media and other electronic distractions that can disrupt the concentration of other students in the classroom is NOT allowed.

NOTE ON ACADEMIC INTEGRITY AND CHEATING POLICY

The principles of truth and honesty are fundamental to the educational process and the academic integrity of the University. All students have a right to expect fair and honest evaluation of their work. CHEATING UNDERMINES THIS EXPECTATION AND WILL NOT BE TOLERATED.

Students must avoid the following misconduct behaviors that are considered as cheating:

DO NOT exchange ID badges to collect presence among classmates who cannot attend a lecture.

DO NOT share answers of quizzes during exams.

Any student found by the instructors to be cheating will receive a failing grade for the exam or other graded work, and will be reported to the Course's Coordinator and Instructors' Committee. The instructors may, at their discretion, decide to give a failing grade for the course in severe cases of

academic dishonesty.

8. learning verification methods

The examination consists of an oral test with questions pertaining to the content of all course modules (the number of questions given is proportional to the number of CFUs for each module) and is aimed at ascertaining the student's understanding of the topics and their ability to explain, with propriety of language and critical sense, the content. The student will be able to achieve the maximum score (30/30 cum laude) by answering correctly, completely, and exhaustively all questions from all teaching modules, demonstrating critical and integration skills of the content learned. Among the methods of evaluation envisaged, there can be also other forms such as the deepening and critical exposition of scientific articles, the execution of theoretical-practical exercises, and the exposition of selected topics through power-point presentations. The latter methods of evaluation can be carried out as tests in progress. The objective of the examination thus organized is to assess the student's acquisition of the following skills and knowledge:

Knowledge and understanding of the topics and of the experimental methodologies covered in the program

Applying knowledge and understanding - Knowledge of the theoretical concepts governing stem cell biology and research as well as the main scientific methodologies applied in the field, in order to identify innovative approach and fully comprehend their applications in regenerative medicine.

Making judgements*:* showing the ability to make cross-cutting connections on the topics covered and develop an appropriate methodological approach in relation to different biological problems*.*

Communication skills *by* showing adequate mastery of language and correct technical/scientific terminology

Learning skills through the ability to investigate and address issues of biological interest independently, using critical reasoning and through the recognition of the appropriate experimental approaches.

9. program

<STEM CELL BIOLOGY >

-Generalities, classifications and historical background on stem cells.

-Stem cell properties: asymmetric division and cell cycle, morphological and functional aspects, molecular basis of stemness.

- Differential potentiality and plasticity of stem cells: totipotency, pluripotency, multipotency.
- Molecular bases of differentiative plasticity.
- Embryonic stem cells vs somatic stem cells.
- Main tissue sources of somatic stem cells: perinatal sources (placenta, umbilical cord), postnatal adult tissues (bone marrow, adipose tissue).
- Biological properties of hematopoietic stem cells and mesenchymal stromal cells.
- Characteristics and homeostatic mechanisms of stem cell niches.

- Mechanisms of action: differentiation vs paracrine activity.
- Stromal stem cells and immunomodulation.
- Placental stem cells and their derivatives, biological properties and mention of applications in immune-mediated and inflammatory diseases.
- Introduction to ex vivo isolation and expansion methods of hematopoietic and mesenchymal stromal stem cells.
- Induced pluripotent cells (iPSCs), hints on production protocols and experimental applications.

<STEM CELL BIOLOGY LAB>

- General rules of behavior in a laboratory; main risk factors present in laboratories, chemical and biological risk, definition of biological safety levels; Personal Protective Equipment (PPE)
- How to record data and structure the lab notebook according to the type of experiment being conducted, what information to report, data tracking.
- Basic techniques of working under aseptic conditions
- Stem cell isolation techniques (hematopoietic stem cells and mesenchymal stromal cells).
- Maintenance and expansion of cell cultures
- Techniques for phenotypic characterization of primary cells in culture.
- Protocols for induction of in vitro differentiation and morphological and molecular analysis of differentiation potential.
- Cryopreservation

<CELLULAR SECRETOME: COMPONENTS AND PROPERTIES >

- Cells vs secretome, pros and cons in therapy
- What is secretome, methods of secretome preparation
- Vesicles, exocytosis, transdendocytosis, biogenesis
- Methods of characterization and isolation of vesicles
- The corona
- Application of the secretome in clinical trials, pros and cons and where we are now
- Preservation methods (lyophilization) and industrial translation
- Potency assay for therapeutic evaluation of EVs and the various fractions comprising the secretome

<CELLULAR SECRETOME: COMPONENTS AND PROPERTIES LAB>

- Secretome productions from different sources, on different supports and in different condition
- Secretome collection and quality control (pH, sterility)
- Validation of secretome: evaluation of secretome on lymphocyte proliferation
- Evaluation of secretome activity on target cells

<STEM CELL RESEARCH: AN ANTHROPOLOGICAL QUESTION >

- Reconceptualization of contemporary Science: Cultural changes in the age of Science;
- The impact on Anthropology 1: Human Identity in Paleoanthropology

- The impact on Anthropology 2: Post-Modernity – Post-Humanism – Trans-Humanism (Human Enhancement)
- The value of the Human Body in the context of the Human Person and the problem of the Soul
- Order – Complexity – Emergence in Biology
- Some applications: Future Food – Bio-esthetic and Beauty – Aging – Immortality
- Ethics of the research

<TISSUE REGENERATION DURING EVOLUTION: FROM INVERTEBRATES TO VERTEBRATES>

- Origins of cells in regenerating system
- Epithelization
- Role of the substrate in regeneration
- Tissue interactions and nerve regenerations
- Morphogenesis of regenerating structures