

## What are the overall learning outcomes to be achieved?

The students will acquire in-depth knowledge on structure and function of the skeleton. Becoming familiar with cutting edge technologies to generate in vitro and in vivo models for skeletal diseases, such as gene targeting, CRISPR-CAS and innovative omics techniques. Finally, students will gain insights on disease mechanisms and thus novel therapeutic targets.

## Program of the virtual and face-to-face components

The professor lectures will cover the four topics listed below and will provide the ppt slides and a list of papers (relevant for the field) covering the topics. Each student will express a specific interest in one of the topic and will be asked to select a specific paper that she/he will have to study in more details. First and second choice of topics of interest will be asked in order to cover all the 4 topics.

The students will then work on zoom platform in small groups, based on the selected topic, and they will be asked to prepare a 10-15 min presentation (3 slides per students) live in Pavia and discussion will follow. The presentation should properly contextualize the importance of the paper in the context of the topics presented during the course.

The groups will be ideally formed by students belonging to different Universities and their activity will take advantage of facilitator teachers.

## GENERAL TOPICS

- **Bone: evolutionary developmental biology.** (provided by University of Ghent, Belgium)
- **Modelling skeletal diseases: from cells to mammals.** (provided by University of Paris-Cité, France)
- **Genetics and Omics; from Common to Rare bone diseases.** (provided by University of Barcelona, Spain)
- **Innovative therapy targeting bone signaling pathway.** (provided by University of Pavia, Italy)

### *Teaching Class Specific content*

#### **1. Bone: evolutionary developmental biology. (provided by University of Ghent, Belgium)**

- a. Evolution and Development of Skeletal Tissues: Notochord. *1 hour on line* (Prof Eckhard P Witten)
- b. Evolution and Development of Skeletal Tissues: Cartilages and Bones. *1 hour on line* (Prof Adelbert De Clercq)
- c. Evolution and Development of Skeletal Tissues: Teeth. *1 hour on line* (Prof. Adelbert De Clercq)
- d. Comparative Skeletal Biology. A key to understand human skeletal diseases. *2 hours will be done in presence in June* (Prof Eckhard P Witten/ Adelbert De Clercq)

#### **2. Modelling skeletal diseases: from cells to mammals. (provided by University of Paris-Cité, France)**

- a. Bone cell differentiation (osteoblasts). *1 hour on line* (Prof. Amelie Coudert)
- b. Bone cell differentiation (osteoclasts). *1 hour on line* (Prof Amelie Coudert)
- c. bone cell models. *1 hour on line* (Prof Martine Cohen-Solal)
- d. Bone remodeling and differentiating factors: from humans to mice and back again. *2 hours will be done in presence in June* (Prof Martine Cohen-Solal/ Prof Amelie Coudert)

### **3. Genetics and Omics; from Common to Rare bone diseases. (provided by University of Barcelona, Spain)**

- a. Genetic analyses of complex bone phenotypes; the success of the GWAS approach. 1 hour on line (Prof Kelly Rabionet)
- b. Genetic analyses of Mendelian bone phenotypes; the power of NGS. 1 hour on line (Prof Natàlia Garcia-Giralt)
- c. Single and multi-omics approaches to bone tissue and bone diseases. 1 hour on line (Prof. Susanna Balcells)
- d. Beyond GWAS and NGS: examples of functional analyses of genetic variants associated with bone phenotypes. *2 hours will be done in presence in June* (Prof Kelly Rabionet/ Susanna Balcells)

### **4. Innovative therapy targeting bone signaling pathway. (provided by University of Pavia, Italy)**

- a. WNT modulation using sclerostin antibody in bone fragility disorders. *1 hour on line* (Prof Antonella Forlino)
- b. TGF $\beta$  modulation using TGF $\beta$  antibodies: a novel approach for bone fragility. *1 hour on line* (Prof Roberta Besio)
- c. ER stress modulation in bone disorders using chaperone approaches *1 hour on line* (Prof Roberta Besio)
- d. Autophagy modulation using a drug repurposing therapy approach: a lesson from skeletal disorders. *2 hours will be done in presence in June* (Prof Antonella Forlino)

Attendance is recommended for at least 75% of the classes.

#### **Live start-up meeting**

The course will be presented in an hybrid mode: live at university but all together online.