



SCIENCE, TECHNOLOGY, HEALTH

# Master's degree "Bio-Inspired Materials"

Master Materials Science and Engineering



ECTS  
120 credits



Duration  
2 years



Component  
Collège  
Sciences et  
Technologies  
pour l'Energie et  
l'Environnement  
(STEE)



Language(s)  
English

## Presentation

[Apply here from October to March](#)

**The 2022 class was sponsored by L'Oreal.**

This master's degree aims at offering an educational background connecting the laboratory environment and the living world while responding to ecological and sustainable transition challenges. Mimicking strategies elaborated by Nature represents infinite scientific and technological challenges. These challenges will be taken up through bioinspiration and biomimicry angles keeping in mind environmental awareness and ethics.

We offer our students a unique opportunity to explore and get inspired by living systems to develop novel materials. Our biomimetic approach focuses on cross-disciplinary courses that will make students reconsider how they elaborate syntheses, formulations, and processing of tomorrow's materials as needed by the industrial partners to build our future society

In both the first and the second year of the master's, the students will be trained to draw inspiration from Nature through a biomimetic approach. This multidisciplinary approach, which resorts to both fundamental science and materials engineering, is based on the observation

and comprehension of living organisms within their ecosystems. To succeed in this course, students will have to grasp abstract concepts to design biological models adapted to scientific and technological developments.

The teaching program, comprising lectures, supervised and practical work, and case studies, is primarily centered around student-based teaching strategies including Project-based learning. Entirely in English, teaching is performed by university lecturers and researchers as well as socio-professional stakeholders. The practical works and case studies take place in the laboratories of the Multidisciplinary Research Institute for the Environment and Materials (IPREM CNRS UMR 5254), using high-performance and cutting-edge equipment. Lectures are scheduled at the beginning of the training course to harmonize the basic knowledge of students originating from various educational backgrounds (biology, physics, and chemistry). Through this approach, we wish to develop the student's soft skills to encourage autonomy and stimulate curiosity, creativity, and emotional intelligence. The primary objective is to train future young researchers with special know-how in collaborative thinking and able to drive bio-inspired research projects.

---

## Objectives



- \* Prepare students at an advanced specialized level to meet present and future challenges by adopting the biomimicry philosophy
- \* Obtain basic and requisite knowledge in physics, chemistry, and biology
- \* Awake curiosity and inspire respect for living systems
- \* Develop environmental awareness
- \* Develop collaborative and open working skills
- \* Adhere to the principles of the living world in their scientific approach
- \* Adopt a biomimetic approach with materials from concept to development
- \* Develop engineering research skills to engage in quality and successful research,
- \* Prepare students for leading positions in industry and government Research and Development departments

## Your university

## Skills

At the end of this program, the students in the «**Materials Science and Engineering: Bio-Inspired Materials master's degree**» will be able to:

- \* Prepare innovative bio-inspired materials,
- \* Use surface and volume analytical techniques to achieve a sound command of materials characterization,
- \* Validate, interpret and model experimental results,
- \* Write a report and communicate appropriately with experts,
- \* Produce quality research,
- \* Carry out a research project.

## Additional information

### Scholarships

- \* [EIFFEL Scholarship of Excellence](#)
- \* [Talents' Academy Grants](#) |
- \* [Catalogue des Bourses Campus France](#) |

### The International Master Programs Admission Office

[master.programs@univ-pau.fr](mailto:master.programs@univ-pau.fr)

## Organisation

### Organization

Master 1		
Materials Science and Engineering: Bio-Inspired Materials		
Semester 1		
Course Title	Course Description	ECTS
<b>Mandatory courses</b>		
Elaboration of materials 1	Organic materials/ Polymers: Phases transition and different classes of polymerization	2
Biochemistry	Presentation of principal families of bio-inspired peptides: Cell Penetrating Peptides, Self-	2



	<p>Assembled Peptides (Foldamers, Hydrogels, etc.), Peptidomimetics, Conotoxins, etc.</p> <p>Introduction to their applications in tissue engineering reconstruction, drug delivery, and therapeutic.</p> <p>Study of the solid supported synthesis of bio-inspired peptides and their characterization/analysis.</p>			<p>conditions and how they stimulate, according to conditions, anabolic or catabolic processes to maintain homeostasis. Finally, we will see how cells are capable to induce their own death by initiating a genetically programmed cell death pathway called apoptosis</p>	
			Biomimicry	Introduction and awareness	4
Cell Biology	<p>Cell structure and function: This course aims at recapitulating the main functions and roles of eukaryotic cell structures. Particular attention will be paid to pathways by which cells sense the environmental</p>	2	Introduction to Polymer physics	Main polymer families and recycling	2
			Materials analysis methods	Structural analysis, scattering techniques	2
			Biomimicry approaches	Active pedagogy	3
			French for foreigners or English		2



as a Foreign language		
<b>Electives (10 ECTS)</b>		
The different types of materials and their properties	General introduction, synthesis and materials processing, properties, and applications	2
Environmentally sustainable chemistry:  * Environmental friendly design of materials * Green chemistry		3
Composite materials 1:  * Introduction to composite materials * Mechanical properties of composite materials		2
Project		2
Advanced part design	Fast prototyping, 3D printing	1
<b>Master 1</b>		

<b>Materials Science and Engineering: Bio-Inspired Materials</b>		
<b>Semester 2</b>		
Course Title	Course Description	ECTS
<b>Mandatory courses</b>		
Global challenges ecological transition	Global Climate change (Climate Economics, Risk, Anthropocene...)	2
Thermodynamics macromolecular solution	Polymer solution physical chemistry	2
Materials chemistry in the lab		2
Elaboration of materials 2	Sol-gel chemistry 2 ECTS  Polymer chemistry 2 ECTS	4
Scientific communication	Communication	2
Characterization methods	NMR	2
Work and study internship		3



Carbon footprint and life cycle analysis		2
Project		5
French for foreigners or English as a Foreign language		2
<b>ELECTIVES 6 ECTS</b>		
Physical chemistry of macromolecular solutions		2
Characterization methods	Microscopies	2
Analytical Chemistry	Molecular Mass spectrometry	2
Biochemistry		2

<b>Master 2</b>		
<b>Materials Science and Engineering: Bio-Inspired Materials</b>		
<b>Semester 1</b>		
<b>Course Title</b>	<b>Course Description</b>	<b>ECTS</b>
<b>Mandatory courses (22 ECTS)</b>		

Materials for energy storage and conversion	Get Skills in materials and processes in the field of energy (from storage to conversion) in an industrial and environmental context	4
New materials	Emerging materials in relation to the original properties expected (block copolymers, polymer brushes, gels, sol-gel chemistry, interactive chemistry ...)	4
Colloidal systems and surfactants:  * Methods And Techniques For Polymer-based Materials Synthesis * Interfaces	Basics of the physical chemistry of colloids	4



Polymers and the Environment	Chemical and physicochemical behaviors of natural polymers, their specific features, and potential applications. Behavior and properties of biomass materials	2
Introduction to biological soft matter	Polymers for the living organisms	2
Bio-inspired project	Student-based learning in the project mode	6
French for foreigners or English as a Foreign language		2
<b>Electives (6 ECTS)</b>		
Biology	Plant biology and physiology	2
Nanocomposites and Nanomaterials:  * Industrial copolymers * Nanocomposites * Nanomaterials	Nanomaterials composites	4

Adhesion & Adhesives		4
Composites based on bioresources		2

<b>Master 2</b>		
<b>Materials Science and Engineering: Bio-Inspired Materials</b>		
<b>Semester 2</b>		
Course Title	Course Description	ECTS
Internship	6-month internship in a private or academic laboratory	30

## Trainings

**Internship** : Mandatory

**Internship duration** : 4-6 months

### Master 1

A Minimum of 2 to 4 months of immersion in an academic or private research lab, in France or abroad

### Master 2



Applied research project of at least a 6-month duration in an academic or private research lab

*this research-focused PhD-Track.*

## Admission

### Admission requirements

#### Requirements

- \* Applicants must hold at least a bachelor's degree in chemistry, biology, and physics for the Master 1 level.
- \* Applicants must hold at least a 4-year university level in chemistry, biology, and physics for the Master 2 level

*In 2022-2023, the UPPA is opening a 5-year integrated Master's/PhD program that provides research-intensive training in multiple fields, called the Graduate Program GREEN (GRaduate school for Energetic and Environmental iNnovation). Several courses of study taught entirely in English are part of this program. The Graduate Program GREEN is open to high-potential students from a variety of scientific backgrounds who have completed their undergraduate training with the highest honors. To be selected, candidates must explicitly indicate in their letters of motivation their desire to integrate the Graduate Program GREEN, providing reasons for why they wish to participate in*

#### English Language requirements

- \* Applicants must be fluent in English, both in writing and speaking. An applicant whose native language is not English has to take a recognized international English test.

Minimum required score: **CECRL B2** | 🇬🇧 level in English

#### French Language Requirements

- \* **None**

### How to apply

Apply here from October to March

### Target

International and French students

### Tuition Fees and partial exemptions

Administrative tuition in France is determined at a national level. The French Ministerial Order of April 19, 2019, amended on June 9, 2020, sets university tuition for a Master's Program as follows: European nationals: **€243**, extra-European nationals: **€3770**.

For the academic year 2022-2023, the Board of Directors has extended its policy of automatically providing a **partial reduction of these fees at the UPPA**. As a result, extra-European nationals will be granted automatic partial reductions such that **they will be able to pay the same enrollment fees as European nationals**.

**Extra fees:**



In addition to academic tuition, most students must pay a student body fee (CVEC, which cost €92 in 2020-2021).

*NB: Admitted candidates in any course of study who have taken a break of more than two years from their studies will enroll via the UPPA's **Continuing Education service** (Formation Continue / FORCO). They are exempt from the CVEC, however, they may be subject to a different tuition scale.*

## And after

---

### Further studies

Prospects for employment or further study

## Sectors:

- Chemistry
- Energy (photovoltaic, batteries, fuel cells, artificial photosynthesis ..)
- Environment (non-polluting materials, pollution control materials and storage...)
- Aeronautics (composite materials, surface treatments ...)
- Building (thermal and sound insulating coatings ...)
- Cosmetics & life science

## Fields:

- \* Research and Development

## Positions:

- \* Project Manager
- \* Senior manager in design and development (design engineer)
- \* Senior manager in production (process engineer, production engineer)

- \* Senior manager responsible for quality operations or even production management
- \* Technical Director (R & D)
- \* Teacher-researcher (possible at the end of a doctorate.)

---

## Professional insertion

### Positions:

- \* Research and Innovation Engineer, PhD students
- \* Project Manager
- \* Senior manager in design and development (design engineer)
- \* Senior manager in production (process engineer, production engineer)
- \* Senior manager responsible for quality operations or even production management

## Useful info

---

### Contacts

#### Head of Teaching

Laurent BILLON

✉ laurent.billon@univ-pau.fr

#### Head of Teaching

Corinne Nardin

✉ corinne.nardin@univ-pau.fr

---

### Place

📍 Pau