Chimie ParisTech – Université PSL

Chemistry to innovate and shape the world of tomorrow
1896: Founded by Charles Friedel

Young chemists devoted to industrial careers should have a scientific background as solid as that of those embracing purely academic ones.

- 1899-1907: Directed by Henri Moissan (Nobel Prize winner 1906)
- 1916: First woman embracing engineer career in France
- 1904: Eugène Schueller, founder of L’ORÉAL
Paris and its region

- 816,000 businesses
- 1/3 of the foreign businesses in France
- 1st European center for Fortune 500 multinational companies
  - 1st European center for professional meetings
  - 30% of France’s Gross Domestic Product (GDP)

- Paris among World’s Best Student City (QS)
  - 17 Universities, 40 Graduate Schools of Engineering
  - > 70,000 foreign students (20% of the students of the area)

- 1st European region in R&D
  - 40% of national investment in research and development
  - 95,500 researchers
Chimie ParisTech | PSL belongs to a world class University

- TOP 50 worldwide (QS, THE, ARWU)
- TOP 5 University younger than 50-year-old (QS, THE)
- 1st University among Millennials (THE)
- TOP 100 Leiden – 1st in France
University PSL in a nutshell

- 17,000 students
- 4,500 researchers
- 181 labs
- 91 libraries and museums
- 50 startups founded
- ~70 patents/year
- 2,500 business partnerships
- 150 ERC since 2011
- 27 Nobel
- 10 Fields Medal
- 3 Abel prize
- 48 CNRS Gold medal
- 50 César prize
- 79 Molière prize
- 2 Olympic games medals
- ~70 patents/year
- 2,500 business partnerships
ParisTech – Alliance of graduates schools in engineering

• An exceptional union enabling a unique transdisciplinarity network
• Each School is ranked #1 at the national level in its specific domain

Our shared-values

Excellence based on the model of French “Grandes Écoles”

Openness as a driver for growth: international openness, social diversity, openness to new pedagogical methods

The quest for innovation, key to future successes for our Schools

1 700 PhD candidates

70 international agreements

58 teaching and research chairs

1 500 professors

120 partner companies

90 000 alumni

23/02/2021
EELISA – European Engineering Learning Innovation and Science Alliance

- The European University Alliance that will **transform engineering education and society**
  - One of the 41 Alliance funded by EU Erasmus+

- **Make the engineering degree a European degree**
  - To facilitate international careers

- **Develop innovative engineering training**
  - Apprenticeship, interdisciplinary...

- **Strengthen & recognize social engagement**
  - Links with non-academics via internships, projects...

- **Develop inclusion**
  - A European campus for everyone

- **Gather forces within communities around societal challenges**
  - Researchers, students, third parties working together on solutions

www.eelisa.eu
Our Vision

Provide basics & fundamentals courses in all fields of chemistry illustrated by a cutting-edge research
KEY FIGURES
Training

Highly selected students (50% of women) 350

Researchers and Professors & Associate Professors 140

1 Prof for 3 students

Practical training 40%

Business, management and human skills 20%

20% international students

100% abroad

12 months Mandatory internship
Research & Development

1. Chair With Eco-Systèmes

2 Labcom (joint lab with SMEs)

50% of PhD funded by companies

>40 contracts per year
Chimie Paris Innov

Chimie Paris Innov our incubator cofunded by the European Union
➢ 700 000€ project
➢ Started in 2018
➢ +10 start-ups

Augmented Wood, and next generation of Human-to-Machine Interfaces

Plasma catalysis technology for methanation of CO₂

European patent [EP15202925.2] 2015

Zinc-Air
Cheap and Safe Batteries for Electrical Vehicles & Stationary Electricity Storage
Paris FLOW Tech

Continuous Flow Chemistry Technology Platform

- All activations in one place
- Unique in Europe
- 1.7M€ project
- Business need driven
Institut Carnot

The Carnot network
• 39 Carnot Institutes in France
• Given by the French Ministry of Higher Education, Research & Innovation
• Ambition to foster public/private partnerships

Institut Carnot IPGG Microfluidique represents:
• 350 researchers
• Common theme: flow at tiny scale and its many applications (milli-micro-nano-fluidics)
• Member institutions: Chimie ParisTech | PSL, ENS | PSL, ESPCI Paris | PSL, PSL, CNRS
• Sectors
  ✓ Chemistry
  ✓ Pharmaceuticals
  ✓ Life sciences
  ✓ Energy
  ✓ Environment
  ✓ Luxury goods
Employability of our Engineers

+ 90 % of the students get a job or PhD before the graduation ceremony (~66 % for all engineering schools)

Class 2018 (110 students)
RESEARCH

A world class research made to tackle global societal challenges
Our 3 research joint laboratories with CNRS

Paris Research Institute of Chemistry Materials & Energies

Institute of Chemistry for Life Sciences & Health

Ile-de-France Institute for photovoltaic
Our main research areas

Chemistry for Materials & Energies

- Materials Sciences
- Thin Films and Surfaces
- Chemical Engineering
- Organometallic Chemistry
- Polymerization Catalysis
- Energy
- Microsystems
- Heritage materials
- Nano materials & structures
- Modelisation

Chemistry for Life Sciences & Health

- Analytical physico-chemistry : (electrochemistry, separative methods & coupling of detection techniques)
- Miniaturization
- Imagery
- Organic synthesis and methods for imaging and screening
- Modeling & theoretical Chemistry
- Inorganic Biological Chemistry, Medicinal Inorganic Chemistry, Medicinal Organometallic Chemistry
- Catalysis, Synthesis of Biomolecules and Sustainable Development
Selected examples of our research

✓ Imaging and characterization
✓ Nano and smart materials
✓ Catalysis
✓ Chemical Engineering and flow chemistry
✓ Modeling and simulation
Imaging and characterization

Design of new materials for Imaging and Biophotonic:
Focus on materials design, optical spectroscopy and mechanisms: Oxides and fluorides based nanomaterials used as nanosensors for thermal imaging at nanoscale, cell imaging and in-vivo bio-imaging.

Development of new bio imaging techniques
Methodological development of bimodal and multi-parametric imaging in MRI and optical contrast agents

Electrochemical microscopy for 3D Morphology and cartography of real time reactivity of biological systems
Characterization and imaging

Characterization of surfaces
Surface spectroscopies and microscopies: X-Ray photoelectron spectroscopy (XPS), time-of-flight secondary ion mass spectrometry (ToF-SIMS), scanning probe microscopes (STM, AFM).

Structural Metallurgy
Investigation of microstructures/mechanical properties relationships using advanced characterization methods (“in situ” mechanical testing, EBSD, TEM, high energy synchrotron X-rays diffraction)
Ancient & Heritage materials

- Authentification and conservation of cultural heritage artifacts

Analytical techniques
Nano & smart materials

Nanostructured Materials for photovoltaics & optoelectronics
Hybrid solar cells (perovskite/dye sensitized/Quantum Dot)

Crystals and Quantum State Dynamics: Control of non-classical optical & spin states in rare earth doped single crystals & nanoscale systems.


Smart Polymers
Self-assemblies: amphiphilic copolymers & liquid crystal polymers
Polymer nanoparticles for drug delivery and bioimaging: fluorescent self-assemblies with aggregation induced emission

Nanoparticles for Biomedical diagnostic & therapy
Catalysis

Monomers from renewable sources and **renewable monomers**

Organometallic catalysts for **stereoselective polymerisation**

Control and synthesis of polymer based nano-objects

Catalysts for **tandem catalysis**

**Catalysis & Metal-Organocatalysis**
step and atom-economical processes; solventless reactions, chemistry in water; Fe, Ru, Rh, Pt, Cu, In, Pd-catalyzed reactions for C-H, C-C & C-N bond formation; asymmetric reduction

**Total Synthesis of Biomolecules**
Chemical engineering and flow chemistry

- Deposition of coatings by innovative plasmas Processes
- Plasma Processes for depollution & recycling
- CO₂ methanisation by plasma assisted catalyst
- Flow chemistry for Functionalisation and Synthesis of molecules and polymers
Modeling and theory

Development of new methods (electronic structure, environment): DFT approaches, embedding models, solvent models; Implementation in largely distributed codes

Modelling and design molecule based devices: photovoltaics, AIE, light activated devices

Properties of biologically relevant molecules: Photo Dynamic Therapy, 2 Photons Absorption, DNA intercalators...

Modeling of surfaces and materials: reactivity, properties

Modeling of soft and porous materials

Modelling of catalytic reaction mechanisms and optimization (homogeneous & heterogeneous)
Excellent facilities for research within Paris

- NMR / Microscopy and spectroscopy...
- New AGLAE @ Musée du Louvre
Pierre Gilles de Gennes
Institute for microfluidics

- National excellence laboratory
- Created in 2011
- € 28.2M project
- To bring together, in a cross-disciplinary domain, experts from various disciplines (Physics, biology, chemistry, technology)
- To develop both basic and applied research

www.institut-pgg.com
HIGHER EDUCATION SYSTEM

Graduate Engineering Schools 5%

PREPARATORY CLASSES
PC1 PC2

Y1 Y2 Y3

Top 5%

Universities 95%

BACHELOR
BA BA2 BA3

1 2 3

French baccalauréat

MASTER
M1 M2

4 5

PhD D1 D2 D3

5%

Master level

PhD D1 D2 D3

Graduate Engineering Schools

BACHELOR

Universities

PhD D1 D2 D3

5%

Master level
Training top level professionals in chemistry

**Year 1**
Towards engineering
- Basic courses
- Team projects
- Management, Economy
- Language and Cultures
- **Work internship 1-2 months**

**Year 2**
Options
- Basic courses & options
- Projects (innovation)
- Management, Economy
- Language
- **Internship - 5 months**

**Year 3**
Specialization
- Projects (entrepreneurship)
- Engineering or Research master
- **Master internship - 6 months**

- **12 months** of mandatory internship
- Regular meetings with **industrials** (conferences, workshops, visits)
Training top level professionals in chemistry

Organic and Bioorganic Chemistry
Solid State Chemistry
Material Science
Nuclear Chemistry

Analytical Chemistry

Chemical and Process Engineering
Environmental science
Theoretical Chemistry
Life and health sciences

Year 1
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Basic courses
Team projects
Management, Economy
Language and Cultures
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Year 2
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Projects (innovation)
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Chimie ParisTech | PSL general presentation
First year: high level scientific skills

1 Sept-31 Dec

Courses
Chemical engineering, Risks, Physicochemistry, analytical, organic chemistry I, Mathematics, quantum mechanics, Computing and programming, Management economy

1 Jan-30 Apr

Courses
Organic chemistry, Quantum chemistry, spectroscopy, Crystallography, solid state chemistry, organic chemistry II, Numerical methods

Transdisciplinary project
team work on social, economical or environmental issues

1 May-30 Jul

Lab project
team work in a lab

Work internship
(1 or 2 months)
Second year: New applications

1 Sept-31 Dec
Common bases
Chemical engineering, Metallurgy, Polymers, Analytical chemistry II, Biochemistry, Nuclear energy and radioactivity, Thermostatistics and modelization, Inorganic chemistry

1 Jan-30 Mar
Options
Molecular chemistry Materials Chemical engineering Analytical and Biological Chemistry Biotechnologies

1 Apr-30 Aug
Internship (4-5 months)
Techno Team project (1/2 day per week) teamwork Building of a prototype

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Third year: specialization industrial innovation and/or research

1 Sept - 31 Jan

Engineering

Biotechnologies
Sustainable processes & materials
Industrial processing
Green organic chemistry
Cosmetology and Formulation
Energies

1 Feb - 31 Jul

Internship
(6 months)
• Master in Chemistry with 6 tracks
  • Molecular Chemistry (FR)
  • Chemistry of Materials (FR)
  • Analytical, Physical and Theoretical Chemistry (FR)
  • Chemical Engineering (FR)
  • Chemistry and Life Sciences (EN)
  • Chemistry & Innovation (EN)

https://www.psl.eu/en/education/masters-degree-chemistry
Masters @ Chimie ParisTech | PSL

• Material Science and engineering
  – Materials and Engineering Sciences in Paris (EN)
  – Materials of the future, Design and Engineering (FR)
  – Microfluidics, fluid science engineering (FR)


• Nuclear Energy with université PARIS-SACLAY
  – Fuel Cycle (EN)

Other Masters with Chimie ParisTech | PSL involvement

• Energy (EN)
  – Sustainable Energy & Materials
  – Energy Efficiency
  – Decarbonation of fuels
  – Renewable Energy, grids
  
https://www.psl.eu/en/education/master-s-degree-energy

• BME BioMedical Engineering with
  – Bioimaging (EN)
  
https://psl.eu/en/education/master-s-degree-biomedical-engineering
Our PhD programmes

• Chemical engineering and advanced technology

• Physical chemistry and analytical chemistry

• Molecular chemistry

• Material physics and chemistry

https://www.chimieparistech.psl.eu/en/programs/phd/
IMPLEMENTATION OF EXCHANGES
Our International network
Regular international mobility Exchange
“engineering track”

Y1
1 Sept - 31 Dec → 1 Jan - 30 Apr → 1 May - 30 Jun

Y2
01 Sept - 31 Dec → 01 Jan - 30 Mar → 01 Apr - 30 Aug

Y3
1 Sept - 31 Jan → 1 Feb - 31 Jul

https://www.chimieparistech.psl.eu/erasmus/
International mobility – “Master track”

M1
1 Sept-30 June
Including 3-4 months of Internship

M2
1 Sept-31 Jan
1 Feb-31 Jul
Internship

Double Degree agreement
3 semesters @ Chimie ParisTech | PSL & 2 internships

Y1: 1 Sept-31 Dec → 1 Jan-30 Apr → 1 May-30 Jun
Y2: 1 Sept-31 Dec → 1 Jan-30 Mar → 1 Apr-30 Aug
Y3: 1 Sept-31 Jan → 1 Feb-31 Jul

Courses are taught in French
International students services

- **Accommodation**
  - Provided for international students in double degree
  - Affordable rents: ~ €340 pm
  - Possibility of accommodation allowance
  - Average living costs in Paris: €800 pm

- **PSL Welcome Desk (visa...) & Student association**

- **Intensive Language Training Programs**

- **Mentoring by senior students**

- **Active participation in student activities**
Double degree with Russian partners

Prep classes

1st year

2nd year

3rd year

4th year

M1

M2

Selection

NB: Mandatory internship in Russia
Double degree with Russian partners

1st year
2nd year
3rd year
Selection

3rd year
4th year
M1
M2
Double Degree
Double degree with Latin American partners

1st year

2nd year

3rd year

Eng. 3

Eng. 4

Eng. 5

Selection

Double Degree

23/02/2021  Chimie ParisTech | PSL general presentation
Double degree with Latin American partners

1st year
2nd year
3rd year

Selection

Eng. 3
Eng. 4
Eng. 5

internship

Double Degree
Double degree with Chinese partners

1st year
2nd year
3rd year

1st year
2nd year
3rd year
4th year

Selection
Selection

M
M

23/02/2021 Chimie ParisTech | PSL general presentation
Double degree with Chinese partners

1st year

2nd year

3rd year

Selection

3rd year

4th year

M1

M2

Double Degree

23/02/2021
Double degree with Polytechnique Montreal

1st year

2nd year

3rd year

4th year

Selection
Double degree with Polytechnique Montreal

1st year | 2nd year | 3rd year
Selection

Poly
MTL

1st year

2nd year

3rd year

4th year

2nd year

3rd year

4th year

Maitrise

Recherche

Double Degree

Double Degree
Double degree with KAUST

Prep classes | 2nd year | 3rd year

Selection

Internship | M2 | Double Degree | PhD (3 years)

Cosupervision of Master’s thesis

23/02/2021
Double degree with KAUST

Prep classes → M1 → M2 → PhD

Selection → 2nd year → 3rd year → Double Degree
Double degree with INSAT

1st year

2nd year

3rd year

4th year

5th year

Selection

Double Degree

23/02/2021 Chimie ParisTech | PSL general presentation
Double degree with INSAT

1st year
2nd year
3rd year
Selection

2nd year
4th year
M1
M2
Double Degree

23/02/2021 Chimie ParisTech | PSL general presentation
Double degree with KTH

1st year
- Prep classes
- M1

Selection

2nd year
- M2

3rd year

Double Degree

NB: end of study project either in France or in Sweden

Prep classes

BSc 2

M1

M2

23/02/2021
Chimie ParisTech | PSL general presentation
Double degree with KTH

1st year

2nd year

3rd year

Selection

BSc 1

BSc 3

M1

M2

Double Degree

23/02/2021
Double degree with Politecnico di Milano

First year
Second year
Third year

Selection
Double degree with Politecnico di Milano

1st year 2nd year 3rd year

BSc 1 BSc 3 M1 M2

Selection

Double Degree
International Relations Office

Dr. Fethi Bedioui, Director
Mr. Antoine Mercier, Deputy
Mrs. Eloïse Hubert, Manager

international@chimieparistech.psl.eu

Chimie ParisTech | PSL general presentation