PASTEUR COURSE - EDUCATION CENTRE

Program 2025-2026
Hearing: from mechanisms to restoration technologies (HeaR)

Institut Pasteur - Institut de l'Audition, Paris, October 20-31, 2025

Brice Bathelier, Boris Gourevitch & Sandrine Vitry

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Université Paris Cité

FONDATION POUR L'AUDITION

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Healing hearing and speech disorders
FOUNDATION HOSTED BY THE INSTITUT PASTEUR

Institut de l'Audition

INSTITUT Pasteur

HEARING : FROM MECHANISMS TO RESTORATION TECHNOLOGIES (HEAR)

DIRECTORS OF THE COURSE

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HEAD OF PRACTICALS

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Course locations

Day 1, 20/10	Day 2, 21/10	Day 3, 22/10	Day 4, 23/10	Day 5, 24/10
IdA	**IdA**	**IdA**	**IdA**	Institut Pasteur
Day 6, 27/10	Day 7, 28/10	Day 8, 29/10	Day 9, 30/10	Day 10, 31/10
IdA	**IdA**	**IdA**	**IdA**	**IdA**

Location *: Education Center- « Institut Pasteur »*
28 rue du Docteur Roux
75724 PARIS CEDEX 15

Friday, October 24th, 2025: Morning: Room n° 6 - Underground floor (entrance via building 10)
Afternoon: Ground Floor Building N°9

IdA*: Institut de l'Audition, 63 rue de Charenton, 75012 Paris*
Mornings: Ground floor, Auditorium - Afternoons: Ground floor, Teaching room (salle modulable)

Monday, October 20th 2025 — Institut de l' Audition — Day 1: Acoustics, signals and anatomy

Principles of acoustics and wave signal processing:

- *Sound pressure wave propagation*
- *Effects of the physical environment: absorption, reflection, impedance*
- *Sound pressure measurement scales*
- *Soundscapes and sound proofing*
- *Spectral decomposition and spectrograms*
- *Anatomical and biomechanical characteristics of the outer ear*

9:00 - 9:30	**Welcome, general information, student presentation**	**B. Bathellier** **B. Gourevitch, S. Vitry** (IdA, IP - Paris)
9:30 - 10:30	The auditory system - anatomy and principles of hearing	**E. Bathellier** (IdA, IP - Paris)
10:40 - 12:00	Principles of acoustics	**E. Ponsot** (Ircam - Paris)
12:00 - 13:30	***LUNCH BREAK : Buffet at IdA***	
13:30 - 18:00 **All students**	Anatomy, biomechanics and acoustic of the outer ear Introduction to programming of sound synthesis, delivery and recording (Matlab/Python) - Generation of pure tones and more complex sounds - Spectral decomposition - Calibration of sound delivery: intensity and equalisation	**A. Coez** **B. Gourevitch** (IdA, IP - Paris)

Tuesday, October 21st 2025 — Institut de l' Audition — Day 2: Auditory perception and psychoacoustics

- *Perceptual features in auditory perception: tonality, sonic, sound localisation, rugosity*
- *Measurement methods in psychoacoustics.*
- *Temporal sequences and predictions*

9:00 - 10:50	Perception et psychoacoustics	**E. Ponsot** (Ircam - Paris)
11:00 - 12:00	Auditory attributes	**O. Macherey** (CNRS - Marseille)
13:30 - 18:00 **All students**	Using Matlab/Python for generating and quantifying experiments auditory perception experiments Psychoacoustic protocols: - Sound localization - Measuring intensity perception - Simple auditory illusions	**O. Macherey** **B. Gourevitch** (IdA, IP - Paris)

Wednesday, October 22nd 2025 Institut de l' Audition Day 3: Mechano-electric transduction and amplification

- *Physical principles governing the mechano-electric transduction and sound amplification.*
- *Molecules, cells and structures involved in sound detection and spectral analysis.*

9:00 - 9:55	Sound amplification and distortions by hair cells	**P. Martin** (Institut Curie - Paris)
10:00 -10:55	Genetics of mechano-electrical transduction	**M. Bowl** (UCL - London)
11:00 -11:55	Cochlear physiology and mechanics	**J. Barral** (IdA, IP - Paris)
13:30 -18:00 **Group 1**	Practical Course 3: Otoacoustic emissions and distorsion products. - *Better understand the meaning of otoacoustic emissions and their link to normal and impaired cochlea performances* - *Electrocochleography*	**P. Avan** (IdA, IP - Paris) /CERIAH staff
13:30 -18:00 **Group 2**	Practical Course 8: Functional exploration of the audiovestibular deficits in transgenic mice: - *ABR recordings and interpretation in Shaker mutant and WT mice, including masking conditions.* - *Behavioral tests for locomotion swimming and occulo-vestibular reflex*	**S. Vitry** (IdA, IP - Paris) /CERIAH staff

Thursday, October 23rd 2025 Institut de l' Audition Day 4: Auditory impairments and cochlear implant

- *Clinical survey of middle and inner ear pathologies (presbyacousia, otoxicity, sound trauma)*
- *Inner and middle ear surgery*
- *Cochlear implants and hearing aids*

9:00 - 10:00	Clinical survey of middle and inner ear pathologies	**D. Dulon, V. Torres Lazo** (IdA, IP - Paris)
10:15 - 11:00	Inner and middle ear surgery	**M. Hoen** (IdA, IP – Paris)
11:15 - 12:00	Hearing aids	**C. Coudert** (Audika - Paris)
	LUNCH BREAK + feedback session	
13:30 -14:00	Inner and middle ear surgery	**S. Sheppard** (IdA, IP – Paris)
All students **14:00 -18:00**	Practical Course 5: - *Simulation of a surgery with a robot or a virtual simulator* - *Analysis of scanner images from post-surgery patients*	**S. Sheppard, V. Torres Lazo** (IdA, IP - Paris)

Friday, October 24th 2025 **Institut Pasteur** **Day 5: Synaptic transmission in the auditory system & organoids**

- *Synaptic exocytosis, neurotransmitters and the molecular specificities of the auditory system from hair cells to brainstem*

9:00 - 10:25	Synapse Anatomy, the Ribbon synaptopathy	**D. Dulon** (IdA, IP - Paris)
10:35 - 12:00	From inner ear development to basic principles of inner-ear organoid generation.	**J Gale** (UCL - London)
13:30 - 18:00 **All students**	Practical Course 6: Dissection and staining of mouse cochlea for imaging in PRACTICAL COURSE 7 on days 7 and 8	**S. Vitry** (IdA, IP - Paris)

Monday, October 27th 2025 **Institut de l' Audition** **Day 6: From molecules to functions**

- *From anatomy to audiology*
- *Circadian rhythms*

9:00 - 10:25	How molecular physiology of the auditory system underpins a new audiology	**P. Avan** (IdA, IP - Paris)
10:35 - 12:00	Circadian control of the peripheral and central auditory system	**B. Canlon** (Karolinska Institute - Stockholm)
13:30 - 18:00 **Group 2**	Practical Course 3: Otoacoustic emissions and distortion products - *Better understand the meaning of otoacoustic emissions and their link to normal and impaired cochlea performances* - *Electrochochleogeography*	**P. Avan** (IdA, IP - Paris) /CERIAH staff
13:30 - 18:00 **Group 1**	Practical Course 8: Funcional exploration of the audiovestibular deficits in transgenic mice: - *ABR recordings and interpretation in Shaker mutant and WT mice including masking conditions.* - *Behavioral tests for locomotion swimming and occulo-vestibular reflex*	**S. Vitry** (IdA, IP - Paris) CERIAH staff

Tuesday, October 28th 2025 Institut de l' Audition Day 7: Central auditory system

- *From genes to functions*
- *Anatomy and physiology of the central auditory system*
- *Main structures, connectivity, receptive fields, neural coding schemes*

9:00 - 10:25	Hereditary auditory and vestibular defects: from genes to functions	**C. Petit** (IdA, IP - Paris)
10:35 - 12:00	Auditory system anatomy and main functions	**J.M. Edeline** (Cnrs - Saclay)
13:30 - 18:00 **Group 1**	Practical Course 4: Access the temporal aspects of auditory processing through field recordings electrophysiology in humans, by in depth dissection of ABR signals to extract the following concepts: - *responding sub-populations.* - *synchrony,* - *stability of unitary responses* - *associated psychoacoustics*	**P. Avan** (IdA, IP - Paris) /CERIAH staff
13:30 - 18:00 **Group 2a**	Practical Course 9: Two-photon imaging in vivo - *Theory of two-photon microscopy and calcium imaging* - *Training on commercial two-photon microscope* - *Imaging in auditory and other sensory cortex in vivo in mice during stimulus presentation* - *Data analysis using state of the art pipelines*	**B. Bathellier** **M. Brunstein** (IdA, IP - Paris)
13:30 - 18:00 **Group 2b**	Practical Course 7: Confocal microscopy of mutant and wild type mice cochlea stained in PRACTICAL COURSE 5. Quantitative analysis for a comparative study of cochlear morphology in normal and hearing-impaired mutant mice.	**M. Brunstein** **S. Vitry** (IdA, IP - Paris)

Wednesday, October 29th 2025 Institut de l' Audition Day 8: Cortical circuits and plasticity

- *Functional architecture of the cortical circuits*
- *Plasticity of the auditory system and critical periods*

9:00 - 10:25	Neural population codes and links with artificial intelligence	**B. Bathellier** (IdA, IP - Paris)
10:35 - 12:00	Experience dependent plasticity in the auditory cortex	**T. Barkat** (University of Basel - Paris)

13:30 - 18:00 **Group 2**	Practical Course 4: Access the temporal aspects of auditory processing through field recordings electrophysiology in humans, by in depth dissection of ABR signals to extract the following concepts: - *responding sub-populations.* - *synchrony,* - *stability of unitary responses* - *associated psychoacoustics.*	**P. Avan** (IdA, IP - Paris) /CERIAH staff
13:30 - 18:00 **Group 1a**	Practical Course 9: Two-photon imaging in vivo - *Theory of two-photon microscopy and calcium imaging* - *Training on commercial two-photon microscope* - *Imaging in auditory and other sensory cortex in vivo in mice during stimulus presentation* - *Data analysis using state of the art pipelines.*	**B. Bathellier** **M. Brunstein** (IdA, IP - Paris)
13:30 - 18:00 **Group 1b**	Practical Course 7: Confocal microscopy of mutant and wild type mice cochlea stained in PRACTICAL COURSE 5. Quantitative analysis for a comparative study of cochlear morphology in normal and hearing-impaired mutant mice.	**M. Brunstein** **S. Vitry** (IdA, IP - Paris

Thursday, October 30th 2025 **Institut de l' Audition** **Day 9: Auditory, cognition and communication: predictive and emotional processing**

The lectures will present the neural bases of auditory perception and communication with an emphasis on vocal, musical, and emotional processing. In particular, they will focus on:

- *recent cognitive and neurophysiological models of auditory processing that emphasize the hierarchical and predictive nature of perception.*
- *the neural pathways and mechanisms involved in the processing of ecologically relevant sounds, with a particular focus on vocal communication signals, whether verbal or non-verbal*

9:00 - 10:25	Auditory perception and predictions	**K. Doelling** (IdA, IP - Paris)
10:35 - 12:00	Vocal communication and auditory emotions	**L. Arnal** (IdA, IP - Paris)
13:30 - 18:00 **All students**	Practical Course 11: Acquisition and analysis of EEG data using classical paradigms and applying the signal processing techniques acquired at the beginning of the course - *data preprocessing and filtering.* - *Evoked potentials (oddball paradigm)* - *Spectro-temporal analysis (auditory steady-state responses)*	**L. Arnal** (IdA, IP - Paris)

- *Gene therapy approaches.*
- *New directions in audiologic exploration opened by genetic results.*

9:00 - 10:25	Replacement Gene Therapy for Inner Ear Defect: from animal models to the clinic	**S. Safieddine** (IdA, IP - Paris)
10:35 - 12:00	Gene editing for hereditary deafness	**A. El Amraoui** (IdA, IP - Paris)
13:30 - 15:30	Course Exam Format of the examen: written exam with question on most theoretical parts of the course (except day 10).	**B. Bathellier, B. Gourevitch** (IdA, IP - Paris)