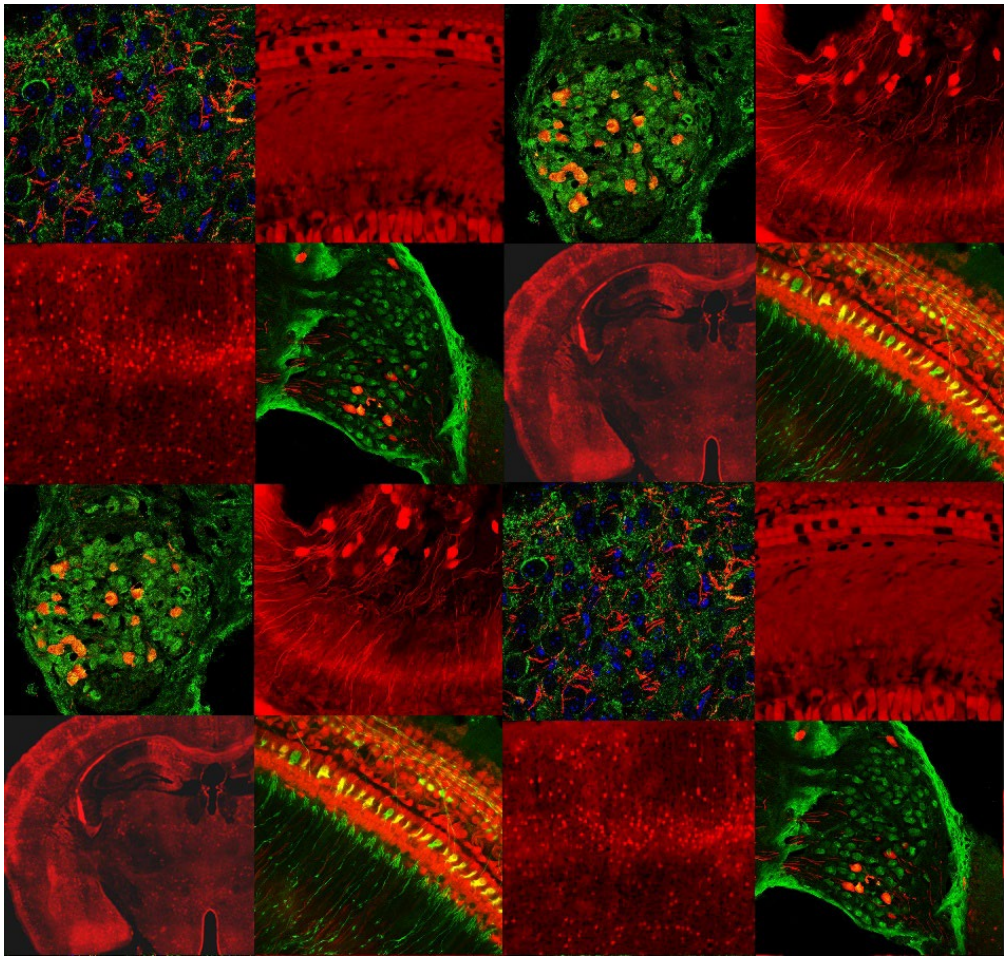
INSTITUT PASTEUR
EDUCATION

PASTEUR COURSE

HEARING: FROM MECHANISMS TO RESTORATION TECHNOLOGIES (HEAR)



Credit: N. Michalski, M. Gagliardini.

PROGRAM
FROM 20 TO 31 OCTOBER, 2025

HEARING COURSE 2025

OCTOBER 20-31, 2025

DIRECTORS OF THE COURSE

BRICE BATHELLIER
INSTITUT PASTEUR
INSTITUT DE L'AUDITION
(PARIS)
✉: brice.bathellier@pasteur.fr

BORIS GOUREVITCH
INSTITUT PASTEUR
INSTITUT DE L'AUDITION
(PARIS)
✉: boris.gourevitch@pasteur.fr

HEAD OF PRACTICALS

SANDRINE VITRY
INSTITUT PASTEUR
INSTITUT DE L'AUDITION
✉: sandrine.vitry@pasteur.fr

Course content

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**

IdA: Institut de l'Audition, 63 rue de Charenton, 75012 Paris

Mornings: Ground floor, Auditorium. Afternoons: Ground floor, Teaching room (salle modulable)

Institut Pasteur: 28 rue du docteur Roux, 75015 paris

Day 1: Acoustics, signals and anatomy

Monday, October 20th 2025, Institut de l'Audition

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 et biomechanical characteristics of the outer ear*

MORNING		
9:00-9:30	**Welcome, general information, student presentation**	
9:30-10:30	The auditory system – anatomy and principles of hearing	B. Bathellier
	BREAK	
10:40-12:00	Principles of acoustics	E. Ponsot
	LUNCH BREAK: Buffet at IdA	
AFTERNOON		
13:30-18:00 All students	Anatomy, biomechanics and acoustics 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

Day 2: Auditory perception and psychoacoustics

Tuesday, June 21st 2025, Institut de l'Audition

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

MORNING		
9:00 – 10h50	Perception et psychoacoustics	E. Ponsot
11:00 - 12:00	Auditory attributes	O. Macherey
	LUNCH BREAK	
AFTERNOON		
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

Day 3: Mechano-electric transduction and amplification

Wednesday, October 22nd 2025, Institut de l'Audition

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

MORNING		
9:00 – 9 :55	Sound amplification and distortions by hair cells	P. Martin
10:00 - 10:55	Genetics of mechano-electrical transduction	M. Bowl
11:00 - 11:55	Cochlear physiology and mechanics	J. Barral
	LUNCH BREAK	
AFTERNOON		
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	Paul Avan, 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 and IdA/CERIAH staff

Day 4: Auditory impairments and cochlear implant

Thursday, October 23rd 2025, Institut de l'Audition

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

MORNING		
9:00-10:00	Clinical survey of middle and inner ear pathologies	V. Torres Lazo + D.Dulon
10:00-10:30	Inner and middle ear surgery	Y. Nguyen
10:30-11:15	Electrical stimulation and coding strategies for cochlear implants	M. Cosnard
11:15-12:00	Hearing aids	C. Coudert
12:15-14:00	**LUNCH BREAK + feedback session**	
AFTERNOON		
14:00-18:00 All students	PRACTICAL COURSE 5: - Simulation of a surgery with a robot or a virtual simulator. - Analysis of scanner images from post-surgery patients.	Y. Nguyen V. Torres Lazo

Day 5: Synaptic transmission in the auditory system & organoids

Friday, October 24th, 2025, Institut Pasteur

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

MORNING		
9:00 – 10 :25	Synapse Anatomy, the Ribbon and synaptopathy	D. Dulon
10:35 - 12:00	From inner ear development to basic principles of inner-ear organoid generation.	J. Gale
	LUNCH BREAK	
AFTERNOON		
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

Day 6: From molecules to functions

Monday, October 27th, 2025, Institut de l'Audition

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

MORNING		
9:00 -10:25	How molecular physiology of the auditory system underpins a new audiology	P. Avan
10:35 - 12:00	Circadian control of the peripheral and central auditory system	B. Canlon
	LUNCH BREAK	
AFTERNOON		
13:30-18:00 Group 2	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	Paul Avan, CERIAH staff
13:30-18:00 Group 1	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 and IdA/CERIAH staff

Day 7: From molecules to functions + Central auditory system

Tuesday, October 28th, 2025, Institut de l'Audition

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

MORNING		
9:00 - 10:25	Hereditary auditory and vestibular defects : from genes to functions	C. Petit
10:35 - 12:00	Auditory system anatomy and main functions.	J.M. Edeline
	LUNCH BREAK	
AFTERNOON		
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 and 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
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.	S. Vitry M. Brunstein

Day 8: Cortical circuits and plasticity

Wednesday, October 29th, 2025, Institut de l'Audition

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

MORNING		
9:00 - 10:25	Neural population codes and links with artificial intelligence	B. Bathellier
10:35 - 12:00	Experience dependent plasticity in the auditory cortex	T. Barkat
	LUNCH BREAK	
AFTERNOON		
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 and 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
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.	S. Vitry M. Brunstein

Day 9: Auditory cognition and communication: predictive and emotional processing

Thursday, October 30th, 2025, Institut de l'Audition

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.*

MORNING		
9:00 - 10:25	Auditory perception and predictions	K. Doelling
	BREAK	
10:35 - 12:00	Vocal communication and auditory emotions	L. Arnal
	LUNCH BREAK	
AFTERNOON		
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

Day 10: Perspectives

Friday, October 31st, 2025, Institut de l'Audition

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

MORNING		
9:00 - 10:25	Replacement Gene Therapy for Inner Ear Defect: from animal models to the clinic	S. Safieddine
10:35 - 12:00	Gene editing for hereditary deafness	A. El Amraoui
	LUNCH BREAK	
AFTERNOON		
13:30-15:30	Course exam. Format of the examen: written exam with question on most theoretical parts of the course (except day 10).	

INSTRUCTORS – PRACTICAL WORK

BRUNSTEIN Maia maia.brunstein@pasteur.fr
Institut Pasteur - Institut de L'audition
Paris, France

NAMES AND ADDRESSES OF THE LECTURERS

Arnal Luc luc.arnal@pasteur.fr
Institut de l'Audition
France, Paris

Avan Paul paul.avan@uca.fr
Institut de l'Audition
France, Paris

Barkat Tania tania.barkat@unibas.ch
University of Basel
Suisse, Bâle

Barral Jérémie jeremie.barral@pasteur.fr
Institut de l'Audition
France, Paris

Bathellier Brice brice.bathellier@pasteur.fr
Institut de l'Audition
France, Paris

Bowl Mike m.bowl@ucl.ac.uk
The Ear institute, University College of London
London, UK

Canlon Barbara barbara.canlon@ki.se
Karolinska Institute
Sweden, Stockholm

Coez Arnaud arnaud.coez.ext@pasteur.fr
Institut de l'Audition
France, Paris

Dulon Didier didier.dulon@pasteur.fr
Institut de l'Audition
France, Paris

Doelling Keith keith.doelling@pasteur.fr
Institut de l'Audition
France, Paris

Edeline Jean-Marc jean-marc.edeline@universite-paris-saclay.fr
NeuroPSI
France, Gif sur Yvette

El Amraoui Aziz aziz.el-amraoui@pasteur.fr
Institut de l'Audition
France, Paris

Gale Jonathan j.e.gale@ucl.ac.uk
The Ear institute, University College of London
London, UK

Macherey Olivier macherey@lma.cnrs-mrs.fr
CNRS, Univ. Aix-Marseille
France, Marseille

Martin Pascal pascal.martin@curie.fr
Institut Curie
France, Paris

Nguyen Yann yann.nguyen@pasteur.fr
Institut de l'Audition
France, Paris

Petit Christine christine.petit@pasteur.fr
Institut de l'Audition
France, Paris

Ponsot Emmanuel emmanuel.ponsot@ircam.fr
IRCAM
France, Paris

Safieddine Saaid saaid.safieddine@pasteur.fr
Institut de l'Audition
France, Paris

CONTACT – INSTITUT PASTEUR ADMINISTRATION

Education Center

Maria PEREZ
Building 10A – Low ground floor

☎ : +33 (0)1 76 53 54 75

✉: **Hear@pasteur.fr**

Register Office

Theory SY
Building 10A – Low ground floor

☎ : +33 (0) 1 53 55 15 54

✉: **enseignement@pasteur.fr**