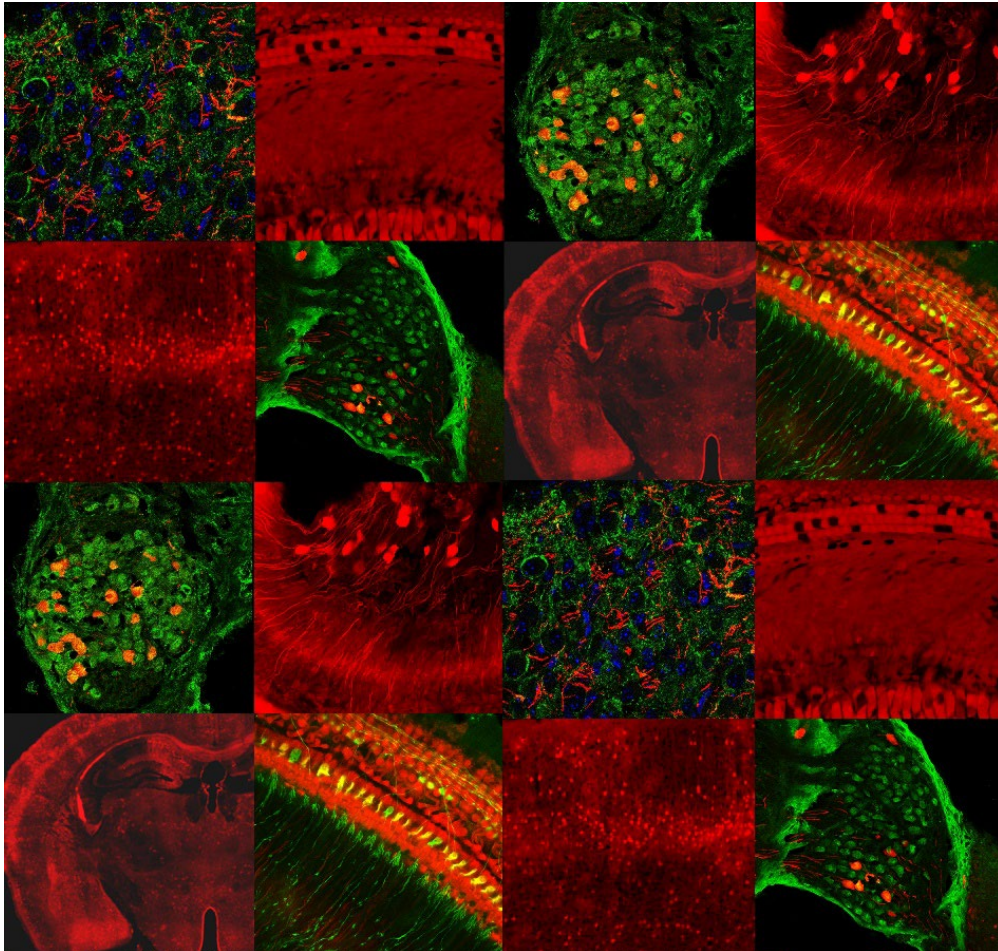


PASTEUR COURSE

HEARING: FROM MECHANISMS TO RESTORATION TECHNOLOGIES (HEAR)



Credit: N. Michalski, M. Gagliardini.

PROGRAM
FROM 3 TO 14 JUNE, 2024



HEARING COURSE 2023-2024

JUNE 3-14, 2024

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.....	3
Day 1: Acoustics, signals and anatomy	4
Day 2: Auditory perception and psychoacoustics.....	4
Day 3: Mechano-electric transduction and amplification	5
Day 4: Auditory impairments and cochlear implant.....	5
Day 5: Synaptic transmission in the auditory system & organoids.....	6
Day 6: From molecules to functions	6
Day 7: Central auditory system.....	7
Day 8: Cortical circuits and plasticity	8
Day 9: Auditory cognition and communication: predictive and emotional processing	9
Day 10: Perspectives	9

Course locations

Day 1, 03/06	Day 2, 04/06	Day 3, 05/06	Day 4, 06/06	Day 5, 07/06
IdA	IdA	IdA	IdA	Institut Pasteur
Day 6, 10/06	Day 7, 11/06	Day 8, 12/06	Day 9, 13/06	Day 10, 14/06
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, June 3th 2024, 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	
10:40-12:30	Principles of acoustics	O. Warusfel
	LUNCH BREAK: Buffet at Ida	

AFTERNOON

13:30-18:00	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
All students		

Day 2: Auditory perception and psychoacoustics

Tuesday, June 4th 2024, Institut de l'Audition

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

MORNING

9:30 - 11:20	Perception et psychoacoustics	D. Pressnitzer
11:30 - 12:30	Auditory attributes	O. Macherey
	LUNCH BREAK	

AFTERNOON

13:30-18:00	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
All students		

Day 3: Mechano-electric transduction and amplification

Wednesday, June 5th 2024, 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	N. Michalski
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 distortion 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, June 6th 2024, Institut de l'Audition

- *Clinical survey of middle and inner ear pathologies (presbycusis, ototoxicity, 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, June 7th 2024, Institut Pasteur

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

MORNING

9:00 – 10 :50	Synapse Anatomy, the Ribbon and synaptopathy	D. Dulon
11:00 - 12:00	From inner ear development to basic principles of inner-ear organoid generation.	R. Etournay
	LUNCH BREAK	

AFTERNOON

13:30-18:00	<u>PRACTICAL COURSE 6</u> : Dissection and staining of mouse cochlea for imaging in PRACTICAL COURSE 7 on days 7 and 8	S. Vitry
All students		

Day 6: From molecules to functions

Monday, June 10th 2024, , 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	<u>PRACTICAL COURSE 3</u> : Otoacoustic emissions and distortion products. - Better understand the meaning of otoacoustic emissions and their link to normal and impaired cochlea performances. - Electrocochleography	Paul Avan, CERIAH staff
Group 2		
13:30-18:00	<u>PRACTICAL COURSE 8</u> : 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
Group 1		

Day 7: From molecules to functions + Central auditory system

Tuesday, June 11th 2023, 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: <ul style="list-style-type: none"> - 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 <ul style="list-style-type: none"> - 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, June 12nd 2024, 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	<u>PRACTICAL COURSE 4</u> : 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	<u>PRACTICAL COURSE 9</u> : 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	<u>PRACTICAL COURSE 7</u> : 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, June 13rd 2024, 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	Keith Doelling
	BREAK	
10:35 - 12:00	Vocal communication and auditory emotions	L. Arnal
	LUNCH BREAK	

AFTERNOON

13:30 - 18:00	<p><u>PRACTICAL COURSE 11:</u> Acquisition and analysis of EEG data using classical paradigms and applying the signal processing techniques acquired at the beginning of the course</p> <ul style="list-style-type: none"> - data preprocessing and filtering - Evoked potentials (oddball paradigm) - Spectro-temporal analysis (auditory steady-state responses) 	L. Arnal
All students		

Day 10: Perspectives

Friday, June 14th 2024, Institut de l'Audition

- Gene therapy approaches.
- New directions in audiology 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	<p>Course exam. Format of the examen: written exam with question on most theoretical parts of the course (except day 10).</p>	
--------------------	---	--

INSTRUCTORS – PRACTICAL WORK

BRUNSTEIN Maia

Institut Pasteur - Institut de L'audition
Paris, France

maia.brunstein@pasteur.fr

NAMES AND ADDRESSES OF THE LECTURERS

Arnal Luc

Institut de l'Audition
France, Paris

luc.arnal@pasteur.fr

Avan Paul

Institut de l'Audition
France, Paris

paul.avan@uca.fr

Barkat Tania

University of Basel
Suisse, Bâle

tania.barkat@unibas.ch

Barral Jérémie

Institut de l'Audition
France, Paris

jeremie.barral@pasteur.fr

Bathellier Brice

Institut de l'Audition
France, Paris

brice.bathellier@pasteur.fr

Canlon Barbara

Karolinska Institute
Sweden, Stockholm

barbara.canlon@ki.se

Coez Arnaud

Institut de l'Audition
France, Paris

arnaud.coez.ext@pasteur.fr

Dulon Didier

Institut de l'Audition
France, Paris

didier.dulon@pasteur.fr

Doelling Keith

Institut de l'Audition
France, Paris

keith.doelling@pasteur.fr

Edeline Jean-Marc

NeuroPSI
France, Gif sur Yvette

jean-marc.edeline@universite-paris-saclay.fr

El Amraoui Aziz

Institut de l'Audition
France, Paris

aziz.el-amraoui@pasteur.fr

Etournay Raphael

Institut de l'Audition
France, Paris

raphael.etournay@pasteur.fr

Macherey Olivier

CNRS, Univ. Aix-Marseille
France, Marseille

macherey@lma.cnrs-mrs.fr

Martin Pascal

Institut Curie
France, Paris

pascal.martin@curie.fr

Michalski Nicolas

Institut de l'Audition
France, Paris

nicolas.michalski@pasteur.fr

Nguyen Yann

Institut de l'Audition
France, Paris

yann.nguyen@pasteur.fr

Petit Christine

Institut de l'Audition
France, Paris

christine.petit@pasteur.fr

Pressnitzer Daniel

Ecole Normale Supérieure
France, Paris

Daniel.Pressnitzer@ens.fr

Safieddine Saaid

Institut de l'Audition
France, Paris

saaid.safieddine@pasteur.fr

Warusfel Olivier

IRCAM
France, Paris

olivier.warusfel@ircam.fr

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