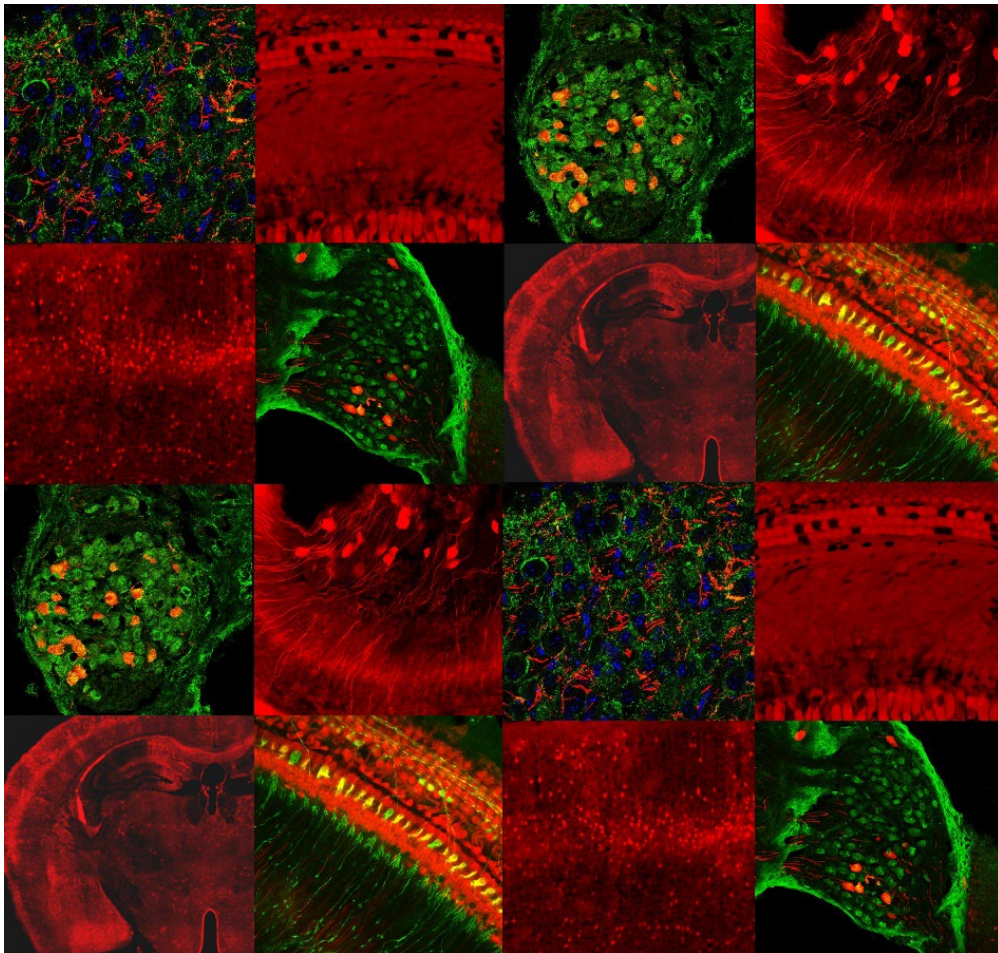


PASTEUR COURSE

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

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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)	A. Coez B. Gourevitch
All students	<ul style="list-style-type: none"> - Generation of pure tones and more complex sounds - Spectral decomposition - Calibration of sound delivery: intensity and equalisation 	

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.	O. Macherey B. Gourevitch
All students	Psychoacoustic protocols: <ul style="list-style-type: none"> - Sound localization - Measuring intensity perception - Simple auditory illusions 	

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	E.Ferrary + 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 E. Ferrary
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Day 5: Synaptic transmission in the auditory system & organoids

Friday, June 9th 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	PRACTICAL COURSE 6 : Dissection of the cochlea of mutant and wild type Shaker mice for staining and imaging in PRACTICAL COURSE 7 on on day 7	S. Vitry
All students		

Day 6: From molecules to functions

Monday, June 10th 2024, Institut Pasteur

- *Development and evolution of the cochlea.*
- *Functional interpretations in the light of the major genes involved.*

MORNING

9:00 -10:25	Hereditary auditory and vestibular defects : from genes to functions	C. Petit
10:35 - 12:00	How molecular physiology of the auditory system underpins a new audiology	P. Avan
	LUNCH BREAK	

AFTERNOON

13:30-18:00	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
Group 2		
13:30-18:00	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
Group 1		

Day 7: Central auditory system

Tuesday, June 11th 2023, Institut de l'Audition

- *Anatomy and physiology of the central auditory system.*
- *Main structures, connectivity, receptive fields, neural coding schemes.*
- *Models of auditory processing*

MORNING

9:00 - 10:25	Auditory system anatomy and main functions.	J.M. Edeline
10:35 - 12:00	Neural population codes and links with artificial intelligence	B. Bathellier
	LUNCH BREAK	

AFTERNOON

13:30-18:00 Group 1	<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: <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	<u>PRACTICAL COURSE 9</u> : 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	<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 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	The forefront of central auditory system research	A. King
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: <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 1a	<u>PRACTICAL COURSE 9</u> : 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 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>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</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>	
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INSTRUCTORS – PRACTICAL WORK

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