Syllabus

N° documenti: 11

Testi del Syllabus

Resp. Did.	**STOCCO GABRIELE**	**Matricola: 011178**

Docenti	**FLORIO CHIARA, 2 CFU** **SGUBIN DONATELLA, 3 CFU** **STOCCO GABRIELE, 2 CFU**
Anno offerta:	**2020/2021**
Insegnamento:	**779SM - NEUROANATOMIA E NEUROFARMACOLOGIA**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2020**
CFU:	**7**
Settore:	**BIO/14**
Tipo Attività:	**B - Caratterizzante**
Anno corso:	**1**
Periodo:	**Primo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	English
Contenuti (Dipl.Sup.)	The course is composed of three parts: PART 1 (Prof. Donatella Sgubin): NEUROANATOMY 1. Central Nervous System (references on embriology, neurons, glial cells) 2. Spinal Cord (surface, sections) 3. Midbrain (surface, sections) 4. Pons (surface, sections) 5. Medulla Oblongata (surface, sections) 6. Cerebellum (surface, nuclei, references on inputs and outputs) 7. Diencephalon (thalamus, subthalamus, epithalamus, ipothalamus, pituitary gland) 8. Cerebral emispheres (surface, gyri, scissures, lobes, areas, white matter, limbic system) 9. Basal ganglia and internal capsule 10. Motor pathways 11. Sensory pathways 12. Dura mater, arachnoid, pia mater 13. Ventricles 14. References on cerebral vasculature (Willis circle, venous sinuses) 15. References on cranial nerves PART 2 (Prof. Chiara Florio): NEUROPHARMACOLOGY PHARMACODYNAMIC: Drug molecular target: classification. Dose-effect relationship: Gradual and quantal dose-response curves. Affinity and intrinsic efficacy. Allosteric modulation. PHARMACOKINETIC: ADME (drug absorption, distribution, metabolism and

excretion). Distribution volume, Renal clearance, Elimination half-time. Bioavailability and Bioequivalence. Pharmacokinetic models: linear and non-linear.
THE AUTONOMIC NERVOUS SYSTEM: Anatomical and functional aspects. Cholinergic transmission: nicotinic and muscarinic receptors, classification and pharmacological features. Adrenergic transmission: receptor classification and pharmacological features.
THE ENDOGENOUS OPIOIDS' SYSTEM: Endogenous opioids synthesis and degradation. Opioid receptors classification and pharmacological features
PART 3 (Prof. Gabriele Stocco): PHARMACOGENOMICS AND DRUGS OF THE CENTRAL NERVOUS SYSTEM
Elements of human genetic variation - basis on genetic variants affecting protein function and epigenetic effects of pharmacological relevance
OPIOIDS and opioid derivatives: pharmacogenomics aspects
ANTIDEPRESSANT DRUGS: ethiopathogenesis of depression. The monoaminergic, neuroendocrine and neurotrophic theories. Antidepressant drugs classifications and mechanisms of action
ANTIPSYCHOTIC DRUGS: ethiopathogenesis of psychosis. The dopaminergic and neurodevelopmental theories. Typical and atypical antipsychotic drugs and mechanisms of action. ANXIOLYTIC DRUGS. Neuronal circuits of anxiety. Anxiolytic drugs: classification and mechanisms of action
ANTI-EPILEPTIC DRUGS: ethiopathogenesis of epilepsy. Antiepileptic drugs: classification and mechanisms of action

Testi di riferimento

Part 1: Computer-aided teaching material will be supplied
Parts 2 and 3: Rang, Ritter, Flower, Henderson "Rang & Dale's Pharmacology" Eighth Edition, Elsevier 2016

Obiettivi formativi

The aim of the part 1 is to provide students with a basic understanding of the structural organization of the human central nervous system in sufficient depth to form the basis for further clinical or research studies of the nervous system.
The purpose of the parts 2 and 3 is to provide robust basis of Neuropharmacology, discussing the principles at the basis of the pharmacokinetic, pharmacodynamics and pharmacogenomics properties of drugs, particularly of those acting at the peripheral and central nervous system
1) Knowledge and understanding: at the end of the course, the students should have acquired the basic notions for the comprehension of the pharmacokinetic and pharmacodynamics properties of drugs and of their mechanism of action, with particular reference to drugs acting at the central nervous system.
2) Applying knowledge and understanding: at the end of the course, the students should be able to use the knowledges acquired (see point 1) for a proper use of drugs in experimental set-ups (in vivo as well as in vitro) as tools to validate hypothesis regarding the involvement of endogenous neurotransmitters in controlling physio-pathological conditions
3) Making judgements: at the end of the course, the students should be able to apply their pharmacokinetic and pharmacodynamics knowledges for a critical consideration of experimental results aimed at investigating the involvement of signaling molecules in physiological and pathological processes
4) Communication skills: at the end of the course, the students should be able to discuss clearly and with appropriate scientific terms pharmacological concepts
5) Learning skills: at the end of the course, the students should have a well-build background that should enable them to continue to enlarge autonomously and critically their knowledges about the pharmacokinetic and pharmacodynamics properties of drugs

Prerequisiti

Part 1: Knowledge of the fundamentals of cytology, biology, histology.
Parts 2 and 3: Knowledge of principles of synaptic transmission and of mechanisms of intracellular signaling transduction pathways

Metodi didattici	Part 1: frontal lectures Parts 2 and 3: Computer-aided frontal lectures (slides with images and short texts reassuming the essential aspects of the lessons)
Altre informazioni	Part 1: Computer-aided teaching material will be supplied Part 2 and 3: Students are provided by the slides used during the frontal lessons thought Moodle. For further information, students are invited to contact dott. Florio by mail (florioc@units.it) using their institutional E-mail address Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
Modalità di verifica dell'apprendimento	Part 1: Students are required to take a final oral examination. Parts 2 and 3: At the end of the course, students are required to take a final oral examination of 20-40 min consisting on three different topics covering the course program (1. Basic Pharmacology (pharmacokinetic and pharmacodynamics) or Autonomous nervous system, 2. Pharmacogenomics and 3. Drugs acting at the Central Nervous System). The student should demonstrate to be able to link together different topics of the program and to communicate the acquired knowledges in a precise and efficacious manner. The mark/30 must be equal or higher than 18. The final mark/30 is the arithmetic mean of Part 1 (Neuroanatomy) and Parts 2-3 (Neuropharmacology and Pharmacogenomics)
Programma esteso	The course is composed of three parts: PART 1 (Prof. Donatella Sgubin): NEUROANATOMY 1. Central Nervous System (references on embriology, neurons, glial cells) 2. Spinal Cord (surface, sections) 3. Midbrain (surface, sections) 4. Pons (surface, sections) 5. Medulla Oblongata (surface, sections) 6. Cerebellum (surface, nuclei, references on inputs and outputs) 7. Diencephalon (thalamus, subthalamus, epithalamus, ipothalamus, pituitary gland) 8. Cerebral emispheres (surface, gyri, scissures, lobes, areas, white matter, limbic system) 9. Basal ganglia and internal capsule 10. Motor pathways 11. Sensory pathways 12. Dura mater, arachnoid, pia mater 13. Ventricles 14. References on cerebral vasculature (Willis circle, venous sinuses) 15. References on cranial nerves PART 2 (Prof. Chiara Florio): NEUROPHARMACOLOGY PHARMACODYNAMIC: Drug molecular target: classification. Dose-effect relationship: Gradual and quantal dose-response curves. Affinity and intrinsic efficacy. Allosteric modulation. PHARMACOKINETIC: ADME (drug absorption, distribution, metabolism and excretion). Distribution volume, Renal clearance, Elimination half-time. Bioavailability and Bioequivalence. Pharmacokinetic models: linear and non-linear. THE AUTONOMIC NERVOUS SYSTEM: Anatomical and functional aspects. Cholinergic transmission: nicotinic and muscarinic receptors, classification and pharmacological features. Adrenergic transmission: receptor classification and pharmacological features. THE ENDOGENOUS OPIOIDS' SYSTEM: Endogenous opioids synthesis and degradation. Opioid receptors classification and pharmacological features PART 3 (Prof. Gabriele Stocco): PHARMACOGENOMICS AND DRUGS OF THE CENTRAL NERVOUS SYSTEM Elements of human genetic variation - basis on genetic variants affecting protein function and epigenetic effects of pharmacological relevance OPIOIDS and opioid derivatives: pharmacogenomics aspects ANTIDEPRESSANT DRUGS: etiopathogenesis of depression. The monoaminergic, neuroendocrine and neurotrophic theories.

Antidepressant drugs classifications and mechanisms of action
ANTIPSYCHOTIC DRUGS: ethopathogenesis of psychosis. The dopaminergic and neurodevelopmental theories. Typical and atypical antipsychotic drugs and mechanisms of action. ANXIOLYTIC DRUGS. Neuronal circuits of anxiety. Anxiolytic drugs: classification and mechanisms of action
ANTI-EPILEPTIC DRUGS: etiopathogenesis of epilepsy. Antiepileptic drugs: classification and mechanisms of action

Testi in inglese

English

The course is composed of three parts:
PART 1 (Prof. Donatella Sgubin): NEUROANATOMY
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2. Spinal Cord (surface, sections)
3. Midbrain (surface, sections)
4. Pons (surface, sections)
5. Medulla Oblongata (surface, sections)
6. Cerebellum (surface, nuclei, references on inputs and outputs)
7. Diencephalon (thalamus, subthalamus, epithalamus, ipothalamus, pituitary gland)
8. Cerebral emispheres (surface, gyri, scissures, lobes, areas, white matter, limbic system)
9. Basal ganglia and internal capsule
10. Motor pathways
11. Sensory pathways
12. Dura mater, arachnoid, pia mater
13. Ventricles
14. References on cerebral vasculature (Willis circle, venous sinuses)
15. References on cranial nerves
PART 2 (Prof. Chiara Florio): NEUROPHARMACOLOGY
PHARMACODYNAMIC: Drug molecular target: classification. Dose-effect relationship: Gradual and quantal dose-response curves. Affinity and intrinsic efficacy. Allosteric modulation.
PHARMACOKINETIC: ADME (drug absorption, distribution, metabolism and excretion). Distribution volume, Renal clearance, Elimination half-time. Bioavailability and Bioequivalence. Pharmacokinetic models: linear and non-linear.
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ANTI-EPILEPTIC DRUGS: ethiopathogenesis of epilepsy. Antiepileptic drugs: classification and mechanisms of action

	Part 1: Computer-aided teaching material will be supplied Parts 2 and 3: Rang, Ritter, Flower, Henderson "Rang & Dale's Pharmacology" Eighth Edition, Elsevier 2016
	The aim of the part 1 is to provide students with a basic understanding of the structural organization of the human central nervous system in sufficient depth to form the basis for further clinical or research studies of the nervous system. The purpose of the parts 2 and 3 is to provide robust basis of Neuropharmacology, discussing the principles at the basis of the pharmacokinetic, pharmacodynamics and pharmacogenomics properties of drugs, particularly of those acting at the peripheral and central nervous system 1) Knowledge and understanding: at the end of the course, the students should have acquired the basic notions for the comprehension of the pharmacokinetic and pharmacodynamics properties of drugs and of their mechanism of action, with particular reference to drugs acting at the central nervous system. 2) Applying knowledge and understanding: at the end of the course, the students should be able to use the knowledges acquired (see point 1) for a proper use of drugs in experimental set-ups (in vivo as well as in vitro) as tools to validate hypothesis regarding the involvement of endogenous neurotransmitters in controlling physio-pathological conditions 3) Making judgements: at the end of the course, the students should be able to apply their pharmacokinetic and pharmacodynamics knowledges for a critical consideration of experimental results aimed at investigating the involvement of signaling molecules in physiological and pathological processes 4) Communication skills: at the end of the course, the students should be able to discuss clearly and with appropriate scientific terms pharmacological concepts 5) Learning skills: at the end of the course, the students should have a well-build background that should enable them to continue to enlarge autonomously and critically their knowledges about the pharmacokinetic and pharmacodynamics properties of drugs
	Part 1: Knowledge of the fundamentals of cytology, biology, histology. Parts 2 and 3: Knowledge of principles of synaptic transmission and of mechanisms of intracellular signaling transduction pathways
	Part 1: frontal lectures Parts 2 and 3: Computer-aided frontal lectures (slides with images and short texts reassuming the essential aspects of the lessons)
	Part 1: Computer-aided teaching material will be supplied Part 2 and 3: Students are provided by the slides used during the frontal lessons thought Moodle. For further information, students are invited to contact dott. Florio by mail (florioc@units.it) using their institutional E-mail address Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
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The course is composed of three parts:
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4. Pons (surface, sections)
5. Medulla Oblongata (surface, sections)
6. Cerebellum (surface, nuclei, references on inputs and outputs)
7. Diencephalon (thalamus, subthalamus, epithalamus, ipothalamus, pituitary gland)
8. Cerebral emispheres (surface, gyri, scissures, lobes, areas, white matter, limbic system)
9. Basal ganglia and internal capsule
10. Motor pathways
11. Sensory pathways
12. Dura mater, arachnoid, pia mater
13. Ventricles
14. References on cerebral vasculature (Willis circle, venous sinuses)
15. References on cranial nerves
PART 2 (Prof. Chiara Florio): NEUROPHARMACOLOGY
PHARMACODYNAMIC: Drug molecular target: classification. Dose-effect relationship: Gradual and quantal dose-response curves. Affinity and intrinsic efficacy. Allosteric modulation.
PHARMACOKINETIC: ADME (drug absorption, distribution, metabolism and excretion). Distribution volume, Renal clearance, Elimination half-time. Bioavailability and Bioequivalence. Pharmacokinetic models: linear and non-linear.
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PART 3 (Prof. Gabriele Stocco): PHARMACOGENOMICS AND DRUGS OF THE CENTRAL NERVOUS SYSTEM
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ANTI-EPILEPTIC DRUGS: etiopathogenesis of epilepsy. Antiepileptic drugs: classification and mechanisms of action

Testi del Syllabus

Resp. Did.	**TONGIORGI ENRICO**	**Matricola: 005813**

Docenti	**BAJ GABRIELE, 3 CFU** **TONGIORGI ENRICO, 9 CFU**
Anno offerta:	**2020/2021**
Insegnamento:	**741SM - NEUROBIOLOGIA CELLULARE E MOLECOLARE**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2020**
CFU:	**12**
Settore:	**BIO/06**
Tipo Attività:	**B - Caratterizzante**
Anno corso:	**1**
Periodo:	**Primo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	English
Contenuti (Dipl.Sup.)	The purpose of the course is to give an overview of molecular mechanisms that regulate the principal cellular functions of neurons and glial cells. Topics of the course are: PART A (Tongiorgi) The cellular basis of the nervous system: I Cellular diversity of the neurons; II Glial cells; III Glial cells and the formation of the myelin, IV The synapse. Inside the neuron: I Organelles, Golgi apparatus & secretion; II mechanisms of presynaptic secretion; III The postsynaptic density; IV cytoskeleton & molecular motors (axonal transport); V Dendritic spines. Functional cellular neurobiology: I Dendritic mRNA targeting and local protein synthesis; II Neurotrophins and their signalling; III Hippocampal anatomy and LTP. PART B (Baj) This part of the course is focused on the principal techniques used to investigate biological questions related to neuronal growth and differentiation. Practical sessions will be based on the methods to prepare, grow, transfect and measure the morphology of neurons in culture. A brief introduction on the microscopy practices more used in neuroscience research is included. PART C Applied Neurosciences: a short course with the help of specialists from pharmaceutical, biotechnological and nutraceutical industries on the making of new treatments in the field of brain diseases and on technology transfer from the idea to a product.
Testi di riferimento	Articles and handsouts provided by the teachers. Squire et al. “Fundamental neuroscience” “Dendrites” by K. Harris & J.Fiala

Obiettivi formativi	The aim of the course can be summarized as follows; 1) knowledge and understanding: The course is designed to familiarize the students with the concept of the relationship between the structure of the different subcellular structures of a neuron and their role in the physiological functions with emphasys on the molecular mechanisms. 2) Applying knowledge and understanding: The practical and theoretical lectures also aim at introducing the students to the scientific methodology typical of cellular neurobiology. The practical module (Techniques) of the course aims at teaching students how to design a cell-based assay to address specific biological problems in neuroscience 3) Making judgements: The students will have to acquire independence in the evaluation of the best scientific methodology to perform researches in cellular neurobiology. 4) Communication skills and learning skills: The module Applied Neuroscience is a professionalizing short course aims at introducing students to the basic concepts of technology transfer by exposing them to the industrial approaches to develop treatments and diagnostics for brain disorders
Prerequisiti	Basic courses (from a previous degree) in cell biology, histology and physiology
Metodi didattici	Frontal lectures with power point slide projections and short movies (prof. Tongiorgi). Group and individual exercises to be done in the class are included in the course. The course has also a module with practical lab/microscopy exercise and preparatory lessons (Dr.Baj)
Modalità di verifica dell'apprendimento	Written exam on the whole program (+ facultative Oral exam) for Cellular and Molecular Neurobiology and Techniques modules. Written exam are T/F type of responses. Correct answers +0.43, wrong answers - 0.2 points. Exercises in the classroom and a group-essay for Applied Neurosciences. This module can give an extra point of +0.5 or +1 on the final mark which is given by the weighted mean of the other two modules
Programma esteso	CELLULAR AND MOLECULAR NEUROBIOLOGY: LESSONS 1-4. The cellular organization of the nervous system: 1) Neurons & The neural cellular theory, 2) Glial cells and the BBB; 3) Glial cells and the Myelin; 4) Astrocytes and the tripartite synapse. LESSONS 5-6. The synaptic spacialization: 5) Dendritic Spines; 6) History and general features of the synapse. LESSONS 7-12. Inside the neuron: 7) organelles and secretion; 8) molecular mechanisms of protein secretion; 9) structural organization of (excitatory/inhibitory) presynaptic terminals; 10) the postsynaptic density; 11) molecular mechanisms of postsynaptic density maintenance & plasticity; 12) Cytoskeleton. LESSONS 13-19 Molecular cell biology of the neuron: 13) axonal transport; 14) Dynein-kinesins molecular motors; 15) protein synthesis; 16) cellular mRNA localization, translation and degradation; 17) P-bodies, stress granules and the mRNA cycle; 18) Protein degradation and the proteasome; 19) Growth factors/Neurotrophins and their signalling. LESSONS 20-21 Plasticty: 20) The cellular and anatomical structure of the hippocampus; 21)Molecular basis of plasticity at excitatory synapses. PART B (Baj) Lesson 1) Course presentation and introduction to scientific methods and specific models applied to research in neurobiology. Laboratory 1) Cell culture in vitro: substrate preparation and cells seeding. Topic on working in a sterile environment. Laboratory 2) Cell culture in vitro: genetic modification using transfection techniques and cells fixation for additional experiments. Lesson 2) Introduction to microscopy techniques used in neuroscience research. Laboratory 3) Cell culture in vitro: Cells fixation and processing for morphological analysis. Laboratory 4) Histological processing of brain slices in preparation to microscopy sessions. Lesson 3) Specific techniques for specific biological questions. Laboratory 5)

Microscopy revision of histological and cytological preparations. Lesson 4) Morphological measurements. Qualitative and quantitative assays. Revision of the concept presented and open discussion.

APPLIED NEUROSCIENCES: The course is organized every year during the second week of January and lectures are hold by ~12-15 highly qualified experts from industries operating mainly in Italy and Europe. Topics of the lectures are updated every year and generally are subdivided in 5 days of seminars dealing with: DAY 1: Target identification & in vitro drug testing at pharmaceutical companies. DAY 2) Drug discovery for CNS at a Contract Research Organization (CRO). DAY 3) Developing innovative therapeutic approaches at biotech companies. DAY4) Regulatory affairs and technology transfer. DAY 5) What means Innovation and what is technology transfer? – On site visits at Companies or at Area di Ricerca are possible.

Testi in inglese

English

The purpose of the course is to give an overview of molecular mechanisms that regulate the principal cellular functions of neurons and glial cells. Topics of the course are: PART A (Tongiorgi) The cellular basis of the nervous system: I Cellular diversity of the neurons; II Glial cells; III Glial cells and the formation of the myelin, IV The synapse. Inside the neuron: I Organelles, Golgi apparatus & secretion; II mechanisms of presynaptic secretion; III The postsynaptic density; IV cytoskeleton & molecular motors (axonal transport); V Dendritic spines. Functional cellular neurobiology: I Dendritic mRNA targeting and local protein synthesis; II Neurotrophins and their signalling; III Hippocampal anatomy and LTP.
PART B (Baj) This part of the course is focused on the principal techniques used to investigate biological questions related to neuronal growth and differentiation. Practical sessions will be based on the methods to prepare, grow, transfect and measure the morphology of neurons in culture. A brief introduction on the microscopy practices more used in neuroscience research is included.
PART C Applied Neurosciences: a short course with the help of specialists from pharmaceutical, biotechnological and nutraceutical industries on the making of new treatments in the field of brain diseases and on technology transfer from the idea to a product.

Articles and handsouts provided by the teachers.
Squire et al. “Fundamental neuroscience”
“Dendrites” by K. Harris & J.Fiala

The aim of the course can be summarized as follows;
1) knowledge and understanding: The course is designed to familiarize the students with the concept of the relationship between the structure of the different subcellular structures of a neuron and their role in the physiological functions with emphasys on the molecular mechanisms.

2) Applying knowledge and understanding: The practical and theoretical lectures also aim at introducing the students to the scientific methodology typical of cellular neurobiology. The practical module (Techniques) of the course aims at teaching students how to design a cell-based assay to address specific biological problems in neuroscience

3) Making judgements: The students will have to acquire independence in the evaluation of the best scientific methodology to perform researches in cellular neurobiology.

4) Communication skills and learning skills: The module Applied Neuroscience is a professionalizing short course aims at introducing

	students to the basic concepts of technology transfer by exposing them to the industrial approaches to develop treatments and diagnostics for brain disorders
	Basic courses (from a previous degree) in cell biology, histology and physiology
	Frontal lectures with power point slide projections and short movies (prof. Tongiorgi). Group and individual exercises to be done in the class are included in the course. The course has also a module with practical lab/microscopy exercise and preparatory lessons (Dr.Baj)
	Written exam on the whole program (+ facultative Oral exam) for Cellular and Molecular Neurobiology and Techniques modules. Written exam are T/F type of responses. Correct answers +0.43, wrong answers - 0.2 points. Exercises in the classroom and a group-essay for Applied Neurosciences. This module can give an extra point of +0.5 or +1 on the final mark which is given by the weighted mean of the other two modules
	CELLULAR AND MOLECULAR NEUROBIOLOGY: LESSONS 1-4. The cellular organization of the nervous system: 1) Neurons & The neural cellular theory, 2) Glial cells and the BBB; 3) Glial cells and the Myelin; 4) Astrocytes and the tripartite synapse. LESSONS 5-6. The synaptic spacialization: 5) Dendritic Spines; 6) History and general features of the synapse. LESSONS 7-12. Inside the neuron: 7) organelles and secretion; 8) molecular mechanisms of protein secretion; 9) structural organization of (excitatory/inhibitory) presynaptic terminals; 10) the postsynaptic density; 11) molecular mechanisms of postsynaptic density maintenance & plasticity; 12) Cytoskeleton. LESSONS 13-19 Molecular cell biology of the neuron: 13) axonal transport; 14) Dynein-kinesins molecular motors; 15) protein synthesis; 16) cellular mRNA localization, translation and degradation; 17) P-bodies, stress granules and the mRNA cycle; 18) Protein degradation and the proteasome; 19) Growth factors/Neurotrophins and their signalling. LESSONS 20-21 Plasticty: 20) The cellular and anatomical structure of the hippocampus; 21)Molecular basis of plasticity at excitatory synapses. PART B (Baj) Lesson 1) Course presentation and introduction to scientific methods and specific models applied to research in neurobiology. Laboratory 1) Cell culture in vitro: substrate preparation and cells seeding. Topic on working in a sterile environment. Laboratory 2) Cell culture in vitro: genetic modification using transfection techniques and cells fixation for additional experiments. Lesson 2) Introduction to microscopy techniques used in neuroscience research. Laboratory 3) Cell culture in vitro: Cells fixation and processing for morphological analysis. Laboratory4) Histological processing of brain slices in preparation to microscopy sessions. Lesson 3) Specific techniques for specific biological questions. Laboratory 5) Microscopy revision of histological and cytological preparations. Lesson 4) Morphological measurements. Qualitative and quantitative assays. Revision of the concept presented and open discussion. APPLIED NEUROSCIENCES:The course is organized every year during the second week of January and lectures are hold by ~12-15 highly qualified experts from industries operating mainly in Italy and Europe. Topics of the lectures are updated every year and generally are subdivided in 5 days of seminars dealing with: DAY 1: Target identification & in vitro drug testing at pharmaceutical companies. DAY 2) Drug discovery for CNS at a Contract Research Organization (CRO). DAY 3) Developing innovative therapeutic approaches at biotech companies. DAY4) Regulatory affairs and technology transfer. DAY 5) What means Innovation and what is technology transfer? – On site visits at Companies or at Area di Ricerca are possible.

Testi del Syllabus

Resp. Did.	**BATTAGLINI PIERO PAOLO**	**Matricola: 003861**

Docenti	**BALLERINI LAURA, 4 CFU** **BATTAGLINI PIERO PAOLO, 3 CFU**
Anno offerta:	**2020/2021**
Insegnamento:	**898SM - NEUROFISIOLOGIA INTEGRATIVA**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2020**
CFU:	**7**
Settore:	**BIO/09**
Tipo Attività:	**B - Caratterizzante**
Anno corso:	**1**
Periodo:	**Secondo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	Inglese
Contenuti (Dipl.Sup.)	The course is organized in two independent modules, given by two different teachers, each of them expert in the particular one. The program is aimed at providing wide information on the more actual approaches to study the activity of the living brain and on fundamental aspects of neuronal integration, from the integrative processes which are carried on by neuronal membranes to neuronal networks, to sensory-motor integration and movement production. Main topics which will be presented. Part 1: Membrane biophysics and cell excitability. Brain waves generation and oscillatory mechanisms. Thalamo-cortical rhythms, spindle waves and delta waves. Role of particular membrane properties, such as voltage dependent ion channels, or synaptic properties. Role of voltage dependent ion channels. Thalamo-cortical rhythm. Part 2: General organization of the spinal cord and spinal reflexes. Brainstem reflexes and function of the superior colliculus. Somaesthesia: coding of sensory information; physiological basis of perception. General organization of the cerebral cortex; primary and associative areas. General organization of motor systems.
Testi di riferimento	Kandel, Principles of Neuronal Science, Mc Graw-Hill Hille “Ionic channels of excitable membranes” Sinauer ass.editors [second or third edition]. In particular from chapter 1 to 5. Other reviews and papers: Annu. Rev. Neurosci. 1997. 20:185–215. J. Physiol. 1995;483;641-663. J. Physiol. 1993;468;669-691. J. Physiol. 1990;431;291-318 Physiol Rev 89: 847–885, 2009; Neuron, Vol. 20, 553–563, March, 1998. Neuron, Vol. 21, 9–12, July, 1998. Annu Rev. Phyiol. 1996 58:299-327. PNAS 2004 vol. 101 no. 52 18195–18199. The Journal of

	Neuroscience, 1993, 13(8): 3284-3299. Cell Calcium 40 (2006) 97–114. Trends in Neurosciences, 2013, Vol. 36, No. 12 pp 738. Additional Selected scientific papers or other didactical material could be provided. The presentation of the lectures and a collection of papers are provided to the students.
Obiettivi formativi	The course aims to ensure that students acquire: 1) Knowledge and undertanding, possessing a thorough knowledge of the fundamental principles underlying the different, but fundamental, aspects of neuronal integration at several levels of the central nervous system. These will comprise different aspects, from the integrative processes which are carried on by neuronal membranes to neuronal networks, main aspect of sensory-motor integration, such as reflex and voluntary movement, till to the more actual approaches to study the activity of the living brain. 2) Applying knowledge and understanding, acquiring the theoretical basis for understanding the most basic procedures related to the acquisition of the most sophisticated biological information from a living brain. 3) Making judgment, acquiring a correct vision of the functioning of the nervosus system, with particular enphasys on the basic processes of integration, both at cellular and systemic level. 4) Communication skills, getting used to the exhibition, in the classroom, of the concepts requested by the teacher, in a stimulated and interactive teaching environment. Students will always be urged to keep in mind the need for scientifically rigorous exposure and communication with colleagues and the general public. They will be stimulated to express themselves in a correct and essential language. 5) Learning skills. At the end of the course the students will posses knowledge and critical reading abilities to continue their training independently, adapting themselves to new knowledge and technologies in the understanding of the integrative processes acting in the brain.
Prerequisiti	Basic knowledge of physics, chemistry and elementary mathematics. Good knowledge of neuroanatomy Knowledge in cell physiology Good knowledge of basic neurobiology
Metodi didattici	Lezioni Frontali. Eventuali cambiamenti alle modalità descritte, che si rendessero necessari per garantire l'applicazione dei protocolli di sicurezza legati all'emergenza COVID19, saranno comunicati nel sito web di Dipartimento, del Corso di Studio e dell'insegnamento.
Altre informazioni	Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
Modalità di verifica dell'apprendimento	Students are required to take a final written examination (part 1) and an oral one (part 2). The written examination consists in a multiple choices test (true/false) and 2 open questions on the topic of the courses. The oral examination consists in a discussion of 20-30 min, during which the student is invited to describe and comment on topics covered in the course.
Programma esteso	The course is organized in two independent modules, given by two different teachers, each of them expert in the particular topic. The program is aimed at providing wide information on fundamental aspects of neuronal integration at several levels in the central nervous system, from the integrative processes which are carried on by neuronal membranes to neuronal networks, to sensory-motor integration and movement production, till to the more actual approaches to study the activity of the living brain Part 1: The main aim of these Lectures is to provide fundamentals in membrane biophysics and in the mechanisms characterizing cell excitability; to translate single cell knowledge towards rules governing small networks behavior in more complex systems. The focus will be on brain waves generation and neuronal mechanisms sustaining such activities, from neuronal membrane to neuronal networks. Oscillatory mechanisms: cellular and network analysis of oscillatory neural systems. Thalamo-cortical rhythms, spindle waves and delta waves, contribution of thalamic neuron properties and circuits. Recent published experimental

evidences will be presented within the framework of theoretical concepts sustaining brain waves mechanisms. At a cellular level experimental evidence supporting the role of particular membrane properties, such as voltage dependent ion channels, or synaptic properties, such as microcircuit organization enabling oscillating activities in cortical networks reflected in EEG activities will be addressed and presented. In particular the following systems will be addressed: Oscillatory mechanisms: cellular and synaptic contributions (network driven rhythmicity vs pacemaker driven one). Voltage dependent ion channels: calcium channels (HVA and LVA) with particular attention to It; IKCa; ICAN; Ih; IIR; IAHP (BK and SK) and others Thalamo-cortical rhythm.
Part 2: Spinal reflexes: monosynaptic reflex and general organization of the spinal cord. Brainstem reflexes: vestibular reflexes, orienting reflex. Stability of visual perception. Somaesthesia: overview of sensory modalities and receptors, sensory transduction, cutaneous mechanoceptors, receptive field, coding of stimulus intensity and duration, tactile acuity, lemniscal and spino-thalamic pathways; primary sensory area, coding of stimulus location and modality. Cerebral cortex: functional subdivisions, Brodman's areas, cortical columns, maturation of the cerebral cortex, cortical plasticity, primary and association areas. Voluntary movement: kinds of movement and their control, motor equivalence, overall organization of the motor systems, pyramidal tract, primary motor cortex, premotor areas, working memory, mirror neurons, functional streams, action and perception, timing for motor production. Basal ganglia and cerebellum: relation of basal ganglia with the cerebral cortex, direct and indirect pathways, disorders of the basal ganglia, functional organization of the cerebellum, input and output pathways, disorders of the cerebellum. Pain: peripheral mechanisms, central pathways and cortical localization. Central control of pain.

Testi in inglese

	English

	The course is organized in two independent modules, given by two different teachers, each of them expert in the particular one. The program is aimed at providing wide information on the more actual approaches to study the activity of the living brain and on fundamental aspects of neuronal integration, from the integrative processes which are carried on by neuronal membranes to neuronal networks, to sensory-motor integration and movement production. Main topics which will be presented. Part 1: Membrane biophysics and cell excitability. Brain waves generation and oscillatory mechanisms. Thalamo-cortical rhythms, spindle waves and delta waves. Role of particular membrane properties, such as voltage dependent ion channels, or synaptic properties. Role of voltage dependent ion channels. Thalamo-cortical rhythm. Part 2: General organization of the spinal cord and spinal reflexes. Brainstem reflexes and function of the superior colliculus. Somaesthesia: coding of sensory information; physiological basis of perception. General organization of the cerebral cortex; primary and associative areas. General organization of motor systems.
	Kandel, Principles of Neuronal Science, Mc Graw-Hill Hille "Ionic channels of excitable membranes" Sinauer ass.editors [second or third edition]. In particular from chapter 1 to 5. Other reviews and papers: Annu. Rev. Neurosci. 1997. 20:185–215. J. Physiol. 1995;483;641-663. J. Physiol. 1993;468;669-691. J. Physiol. 1990;431;291-318 Physiol Rev 89: 847–885, 2009; Neuron, Vol. 20, 553–563, March, 1998. Neuron, Vol. 21, 9–12, July, 1998. Annu Rev. Phyiol. 1996 58:299-327. PNAS 2004 vol. 101 no. 52 18195–18199. The Journal of Neuroscience, 1993, 13(8): 3284-3299. Cell Calcium 40 (2006) 97–114. Trends in Neurosciences, 2013, Vol. 36, No. 12 pp 738. Additional Selected scientific papers or other didactical material could be

	The presentation of the lectures and a collection of papers are provided to the students.
	The course aims to ensure that students acquire: 1) Knowledge and and undertanding, possessing a thorough knowledge of the fundamental principles underlying the different, but fundamental, aspects of neuronal integration at several levels of the central nervous system. These will comprise different aspects, from the integrative processes which are carried on by neuronal membranes to neuronal networks, main aspect of sensory-motor integration, such as reflex and voluntary movement, till to the more actual approaches to study the activity of the living brain. 2) Applying knowledge and understanding, acquiring the theoretical basis for understanding the most basic procedures related to the acquisition of the most sophisticated biological information from a living brain. 3) Making judgment, acquiring a correct vision of the functioning of the nervosus system, with particular enphasys on the basic processes of integration, both at cellular and systemic level. 4) Communication skills, getting used to the exhibition, in the classroom, of the concepts requested by the teacher, in a stimulated and interactive teaching environment. Students will always be urged to keep in mind the need for scientifically rigorous exposure and communication with colleagues and the general public. They will be stimulated to express themselves in a correct and essential language. 5) Learning skills. At the end of the course the students will posses knowledge and critical reading abilities to continue their training independently, adapting themselves to new knowledge and technologies in the understanding of the integrative processes acting in the brain.
	Basic knowledge of physics, chemistry and elementary mathematics. Good knowledge of neuroanatomy Knowledge in cell physiology Good knowledge of basic neurobiology
	Frontal lectures. Any change to the methods described, which become necessary to ensure the application of the safety protocols related to the COVID19 emergency, will be communicated on the web sites of the Department and of the Study Program.
	Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
	Students are required to take a final written examination (parts 1 and 2) and an oral one (part 3). The written examination consists in a multiple choices test (true/false) and 2 open questions on the topic of the courses. The oral examination consists in a discussion of 20-30 min, during which the student is invited to describe and comment on topics covered in the course.
	The course is organized in two independent modules, given by two different teachers, each of them expert in the particular topic. The program is aimed at providing wide information on fundamental aspects of neuronal integration at several levels in the central nervous system, from the integrative processes which are carried on by neuronal membranes to neuronal networks, to sensory-motor integration and movement production, till to the more actual approaches to study the activity of the living brain Part 1: The main aim of these Lectures is to provide fundamentals in membrane biophysics and in the mechanisms characterizing cell excitability; to translate single cell knowledge towards rules governing small networks behavior in more complex systems. The focus will be on brain waves generation and neuronal mechanisms sustaining such activities, from neuronal membrane to neuronal networks. Oscillatory mechanisms: cellular and network analysis of oscillatory neural systems. Thalamo-cortical rhythms, spindle waves and delta waves, contribution of thalamic neuron properties and circuits. Recent published experimental evidences will be presented within the framework of theoretical concepts

sustaining brain waves mechanisms. At a cellular level experimental evidence supporting the role of particular membrane properties, such as voltage dependent ion channels, or synaptic properties, such as microcircuit organization enabling oscillating activities in cortical networks reflected in EEG activities will be addressed and presented. In particular the following systems will be addressed: Oscillatory mechanisms: cellular and synaptic contributions (network driven rhythmicity vs pacemaker driven one). Voltage dependent ion channels: calcium channels (HVA and LVA) with particular attention to It; IKCa; ICAN; Ih; IIR; IAHP (BK and SK) and others Thalamo-cortical rhythm. Part 2: Spinal reflexes: monosynaptic reflex and general organization of the spinal cord. Brainstem reflexes: vestibular reflexes, orienting reflex. Stability of visual perception. Somaesthesia: overview of sensory modalities and receptors, sensory transduction, cutaneous mechanoceptors, receptive field, coding of stimulus intensity and duration, tactile acuity, lemniscal and spino-thalamic pathways; primary sensory area, coding of stimulus location and modality. Cerebral cortex: functional subdivisions, Brodman's areas, cortical columns, maturation of the cerebral cortex, cortical plasticity, primary and association areas. Voluntary movement: kinds of movement and their control, motor equivalence, overall organization of the motor systems, pyramidal tract, primary motor cortex, premotor areas, working memory, mirror neurons, functional streams, action and perception, timing for motor production. Basal ganglia and cerebellum: relation of basal ganglia with the cerebral cortex, direct and indirect pathways, disorders of the basal ganglia, functional organization of the cerebellum, input and output pathways, disorders of the cerebellum. Pain: peripheral mechanisms, central pathways and cortical localization. Central control of pain

Testi del Syllabus

Resp. Did.	**LORENZON PAOLA**	**Matricola: 005762**

Docenti	**BERNAREGGI ANNALISA, 2 CFU** **LORENZON PAOLA, 3 CFU** **SCIANCALEPORE MARINA, 3 CFU**

Anno offerta:	**2020/2021**
Insegnamento:	**901SM - NEUROFISIOLOGIA MOLECOLARE**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2020**
CFU:	**8**
Settore:	**BIO/09**
Tipo Attività:	**B - Caratterizzante**
Anno corso:	**1**
Periodo:	**Primo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	English
Contenuti (Dipl.Sup.)	Contents of the course will be discussed in the light of recent theoretical concepts and experimental data about mechanisms regulating signal transduction, electrical membrane properties of excitable cells and the organization of central and peripheral synapses. The course consists of three Parts and the contents are illustrated hereafter. Part 1 (Prof. Paola Lorenzon): Signal transduction. Intracellular receptors. Receptor tyrosine kinases. G protein-coupled receptors. Signaling through second messengers. Regulation of the intracellular Ca2+ homeostasis. Spatial and temporal organization of intracellular Ca2+ signalling: oscillations and waves. Spatial organization of the intracellular cAMP signalling. Experimental approaches to study the signal transduction in living cells: fluorescent probes and imaging techniques. Part 2 (Prof. Annalisa Bernareggi): Basic principles of synaptic transmission. The neuromuscular junction: anatomic organization, role of trophic factors in neuromuscular junction development (agrin, MusK and rapsyn), properties of neuromuscular nicotinic cholinergic receptors (fetal and adult). Disorders in the neuromuscular junction: myasthenia gravis, the Lambert-Eaton myasthenic syndrome, the congenital myasthenic syndrome and the muscular dystrophies. Part 3 (Prof. Marina Sciancalepore): Synaptic transmission in CNS. Characterization of ion channels, intrinsic membrane electrical properties of neurons, pacemaker mechanisms. Principles of chemical and electrical

	synaptic transmission: quantal release, neurotransmitters, synaptic receptors, integration of synaptic potentials, synaptic plasticity, dendritic spines and their remodelling.
Testi di riferimento	B. Hille, “Ion Channels of Excitable Membranes”, Sinauer Associate Inc. Part I: Chapter 1-5 (third edition). L. R. Squire et al., “Fundamental Neuroscience”, Academic Press. Selected scientific papers or other didactical material could be provided.
Obiettivi formativi	1) Knowledge and understanding The purpose of the course is to provide a sound basis of membrane biophysics, ion channels and receptors to understand the fundamental molecular processes responsible for chemical and electrical cell communication. In particular, the course will focus on the mechanisms responsible for cellular excitability, in both central and peripheral nervous systems. The students will also learn the principal experimental methods for in vitro studies at the single cell level. 2) Applying knowledge and understanding The students will acquire the ability to design the most appropriate experimental plan to investigate molecular mechanisms involved in cell signalling in excitable cells. 3) Making judgements The students will develop abilities for the critical reading of scientific publications, analysis and interpretation of scientific data in the field of cell communication in neurobiology. 4) Communication skills The written test and the oral examination encourage the students to develop scientific writing abilities and oral communication skills. 5) Learning skills At the end of the course the students will posses knowledge and critical reading abilities to continue their training independently, adapting themselves to new knowledge and technologies in cell signalling in neurobiology.
Prerequisiti	Knowledge of fundamental cell biology.
Metodi didattici	Lectures and practical experiences.
Altre informazioni	Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
Modalità di verifica dell'apprendimento	One written test is organised during the course. It consists in writing the abstract of a scientific paper related to the topics of the course. The scientific paper is provided to the students in the classroom with Abstract and Discussion hidden to stimulate their understanding and critical skills and scientific writing abilities. At the end of the course, students are required to take a final oral examination consisting in a discussion of 30 min, during which the students are invited to describe and comment on topics covered in the course. The final mark is decided also considering the results of the written test (+ max 1.5/30).
Programma esteso	Contents of the course will be discussed in the light of recent theoretical concepts and experimental data about mechanisms regulating signal transduction, electrical membrane properties of excitable cells and the organization of central and peripheral synapses. The course consists of three Parts and the contents are illustrated hereafter. Part 1: Signal transduction. Intracellular receptors. Receptor tyrosine kinases. G protein-coupled receptors. Signaling through second messengers. Regulation of the intracellular Ca2+ homeostasis. Spatial and temporal organization of intracellular Ca2+ signalling: oscillations and waves. Spatial organization of the intracellular cAMP signalling. Experimental approaches to study the

signal transduction in living cells: fluorescent probes and imaging techniques.
Part 2: Basic principles of synaptic transmission.
The neuromuscular junction: anatomic organization, role of trophic factors in neuromuscular junction development (agrin, MusK and rapsyn), properties of neuromuscular nicotinic cholinergic receptors (fetal and adult). Disorders in the neuromuscular junction: myasthenia gravis, the Lambert-Eaton myasthenic syndrome, the congenital myasthenic syndrome and the muscular dystrophies.
Part 3: Synaptic transmission in CNS.
Characterization of ion channels, intrinsic membrane electrical properties of neurons, pacemaker mechanisms. Principles of chemical and electrical synaptic transmission: quantal release, neurotransmitters, synaptic receptors, integration of synaptic potentials, synaptic plasticity, dendritic spines and their remodelling.

Testi in inglese

English

Contents of the course will be discussed in the light of recent theoretical concepts and experimental data about mechanisms regulating signal transduction, electrical membrane properties of excitable cells and the organization of central and peripheral synapses.
The course consists of three Parts and the contents are illustrated hereafter.
Part 1 (Prof. Paola Lorenzon): Signal transduction.
Intracellular receptors. Receptor tyrosine kinases. G protein-coupled receptors. Signaling through second messengers. Regulation of the intracellular Ca2+ homeostasis. Spatial and temporal organization of intracellular Ca2+ signalling: oscillations and waves. Spatial organization of the intracellular cAMP signalling. Experimental approaches to study the signal transduction in living cells: fluorescent probes and imaging techniques.
Part 2 (Prof. Annalisa Bernareggi): Basic principles of synaptic transmission.
The neuromuscular junction: anatomic organization, role of trophic factors in neuromuscular junction development (agrin, MusK and rapsyn), properties of neuromuscular nicotinic cholinergic receptors (fetal and adult). Disorders in the neuromuscular junction: myasthenia gravis, the Lambert-Eaton myasthenic syndrome, the congenital myasthenic syndrome and the muscular dystrophies.
Part 3 (Prof. Marina Sciancalepore): Synaptic transmission in CNS.
Characterization of ion channels, intrinsic membrane electrical properties of neurons, pacemaker mechanisms. Principles of chemical and electrical synaptic transmission: quantal release, neurotransmitters, synaptic receptors, integration of synaptic potentials, synaptic plasticity, dendritic spines and their remodelling.

B. Hille, “Ion Channels of Excitable Membranes”, Sinauer Associate Inc. Part I: Chapter 1-5 (third edition). L. R. Squire et al., “Fundamental Neuroscience”, Academic Press.
Selected scientific papers or other didactical material could be provided.

1) Knowledge and understanding
The purpose of the course is to provide a sound basis of membrane biophysics, ion channels and receptors to understand the fundamental molecular processes responsible for chemical and electrical cell communication. In particular, the course will focus on the mechanisms responsible for cellular excitability, in both central and peripheral nervous systems. The students will also learn the principal experimental methods for in vitro studies at the single cell level.
2) Applying knowledge and understanding
The students will acquire the ability to design the most appropriate

	experimental plan to investigate molecular mechanisms involved in cell signalling in excitable cells. 3) Making judgements The students will develop abilities for the critical reading of scientific publications, analysis and interpretation of scientific data in the field of cell communication in neurobiology. 4) Communication skills The written test and the oral examination encourage the students to develop scientific writing abilities and oral communication skills. 5) Learning skills At the end of the course the students will posses knowledge and critical reading abilities to continue their training independently, adapting themselves to new knowledge and technologies in cell signalling in neurobiology.
	Knowledge of fundamental cell biology.
	Lectures and practical experiences.
	Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
	One written test is organised during the course. It consists in writing the abstract of a scientific paper related to the topics of the course. The scientific paper is provided to the students in the classroom with Abstract and Discussion hidden to stimulate their understanding and critical skills and scientific writing abilities. At the end of the course, students are required to take a final oral examination consisting in a discussion of 30 min, during which the students are invited to describe and comment on topics covered in the course. The final mark is decided also considering the results of the written test (+ max 1.5/30).
	Contents of the course will be discussed in the light of recent theoretical concepts and experimental data about mechanisms regulating signal transduction, electrical membrane properties of excitable cells and the organization of central and peripheral synapses. The course consists of three Parts and the contents are illustrated hereafter. Part 1: Signal transduction. Intracellular receptors. Receptor tyrosine kinases. G protein-coupled receptors. Signaling through second messengers. Regulation of the intracellular Ca2+ homeostasis. Spatial and temporal organization of intracellular Ca2+ signalling: oscillations and waves. Spatial organization of the intracellular cAMP signalling. Experimental approaches to study the signal transduction in living cells: fluorescent probes and imaging techniques. Part 2: Basic principles of synaptic transmission. The neuromuscular junction: anatomic organization, role of trophic factors in neuromuscular junction development (agrin, MusK and rapsyn), properties of neuromuscular nicotinic cholinergic receptors (fetal and adult). Disorders in the neuromuscular junction: myasthenia gravis, the Lambert-Eaton myasthenic syndrome, the congenital myasthenic syndrome and the muscular dystrophies. Part 3: Synaptic transmission in CNS. Characterization of ion channels, intrinsic membrane electrical properties of neurons, pacemaker mechanisms. Principles of chemical and electrical synaptic transmission: quantal release, neurotransmitters, synaptic receptors, integration of synaptic potentials, synaptic plasticity, dendritic spines and their remodelling.

Testi del Syllabus

Resp. Did.	**MERONI GERMANA**	**Matricola: 022803**

Docenti	**MALLAMACI ANTONIO, 3 CFU** **MERONI GERMANA, 3 CFU**
Anno offerta:	**2020/2021**
Insegnamento:	**672SM - NEUROGENETICA DELLO SVILUPPO**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2020**
CFU:	**6**
Settore:	**BIO/18**
Tipo Attività:	**B - Caratterizzante**
Anno corso:	**1**
Periodo:	**Secondo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	English
Contenuti (Dipl.Sup.)	The course will address central nervous system embryonic development in vertebrate species, in particular mammals, at genetic, molecular and cellular levels. During the course, the experimental tools necessary for investigating the above topics will be also discussed. The course is given by prof. Germana Meroni and prof. Antonello Mallamaci; the contents of the course are illustrated here below. Early vertebrate development, from cleavage to gastrulation, and body axes specification. Genome editing, forward and reverse genetics, and lineage tracing tools. Neural induction and specification. In vitro modelling of pluripotent state and neural induction: ES cells, somatic reprogramming to iPS cells, SFEBq organoids. Central Nervous System patterning. Neural tube development and closure, neural crest and neural crest cells. Cerebellar histogenesis and development: specification, germinal zones, determination of cerebellar cortex layer neuronal organization and circuits, foliation and sagittal cerebellar compartmentalization. Human genetic disorders of cerebellar development and their mouse models. Rhombo-spinal domains and eye development. Elaboration of positional information along coordinate axes in the anterior brain anlage: general principles and gene effectors. Prosomeric models. Specification of the pallial field. Evolutionary conservation of CNS patterning along the coordinated axes. Neocortical neuronogenesis: generalities, pioneer neurons, glutamatergic neurons of cortical plate, interneurons. Articulation of neocortical glutamatergic neuronogenesis in rodents: proliferative layers, clonal compartments and gene machineries modulating its progression. Evolution of neocortical glutamatergic neuronogenesis: marsupials, rodents, carnivores, primates. Neocortical neuronogenesis: introduction

	to laminar identity specification. Neocortical astrogenesis: timing, clonal articulation, molecular machineries controlling its progression.
Testi di riferimento	Material provided during the course as Lecture presentations and original research articles and reviews. Suggested support book: Developmental Biology, Gilbert, 9th-11th ed.
Obiettivi formativi	The aim of this course is to provide the knowledge and understanding of the nervous system organization through the study of the major events of brain and spinal cord embryological development, at the genetic, molecular and cellular level. The course provides the instruments to understand the experimental genetic approaches that are necessary to undertake neurodevelopment studies (Applying knowledge and understanding). In addition, students are encourage to develop their critical reading of the scientific literature that will be proposed during the course (Making judgements) and that will be tested during the final assessment. During the course, the students will be given the instruments to exploit the literature data and background together with experimental information in order to encourage their development as researchers (Learning abilities). The presence of an oral part in the final assessment is also intended to improve students' Communication skills.
Prerequisiti	Basic knowledge of Molecular Biology, Cellular Biology and Genetics
Metodi didattici	Traditional lectures integrated with Journal clubs discussing seminal research papers on neurodevelopmental genetics.
Altre informazioni	Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites."
Modalità di verifica dell'apprendimento	Students will be required to take a final examination that consists of: i) a written part with 20 multiple choice questions concerning the entire programme of the course (in 1:30-hour-time); ii) a 30-minute oral interview to discuss both the written test, especially to judge the incorrect or partially incorrect answers (if any), as well as other topics addressed during the course. The final mark is assigned based on the result of the written test and on the discussion during the oral part.
Programma esteso	The course will address central nervous system embryonic development in vertebrate species, in particular mammals, at genetic, molecular and cellular levels. During the course, the experimental tools necessary for investigating the above topics will be also discussed. The course is given by prof. Germana Meroni and prof. Antonello Mallamaci; the contents of the course are illustrated here below. Early vertebrate development, from cleavage to gastrulation, and body axes specification. Genome editing, forward and reverse genetics, and lineage tracing tools. Neural induction and specification. In vitro modelling of pluripotent state and neural induction: ES cells, somatic reprogramming to iPS cells, SFEBq organoids. Central Nervous System patterning. Neural tube development and closure, neural crest and neural crest cells. Cerebellar histogenesis and development: specification, germinal zones, determination of cerebellar cortex layer neuronal organization and circuits, foliation and sagittal cerebellar compartmentalization. Human genetic disorders of cerebellar development and their mouse models. Rhombo-spinal domains and eye development. Elaboration of positional information along coordinate axes in the anterior brain anlage: general principles and gene effectors. Prosomeric models. Specification of the pallial field. Evolutionary conservation of CNS patterning along the coordinated axes. Neocortical neuronogenesis: generalities, pioneer neurons, glutamatergic neurons of cortical plate, interneurons. Articulation of neocortical glutamatergic neuronogenesis in rodents: proliferative layers, clonal

compartments and gene machineries modulating its progression. Evolution of neocortical glutamatergic neuronogenesis: marsupials, rodents, carnivores, primates. Neocortical neuronogenesis: introduction to laminar identity specification. Neocortical astrogenesis: timing, clonal articulation, molecular machineries controlling its progression.

Testi in inglese

English

The course will address central nervous system embryonic development in vertebrate species, in particular mammals, at genetic, molecular and cellular levels. During the course, the experimental tools necessary for investigating the above topics will be also discussed.
The course is given by prof. Germana Meroni and prof. Antonello Mallamaci; the contents of the course are illustrated here below.
Early vertebrate development, from cleavage to gastrulation, and body axes specification.
Genome editing, forward and reverse genetics, and lineage tracing tools. Neural induction and specification. In vitro modelling of pluripotent state and neural induction: ES cells, somatic reprogramming to iPS cells, SFEBq organoids. Central Nervous System patterning. Neural tube development and closure, neural crest and neural crest cells. Cerebellar histogenesis and development: specification, germinal zones, determination of cerebellar cortex layer neuronal organization and circuits, foliation and sagittal cerebellar compartmentalization. Human genetic disorders of cerebellar development and their mouse models. Rhombo-spinal domains and eye development. Elaboration of positional information along coordinate axes in the anterior brain anlage: general principles and gene effectors. Prosomeric models. Specification of the pallial field. Evolutionary conservation of CNS patterning along the coordinated axes. Neocortical neuronogenesis: generalities, pioneer neurons, glutamatergic neurons of cortical plate, interneurons. Articulation of neocortical glutamatergic neuronogenesis in rodents: proliferative layers, clonal compartments and gene machineries modulating its progression. Evolution of neocortical glutamatergic neuronogenesis: marsupials, rodents, carnivores, primates. Neocortical neuronogenesis: introduction to laminar identity specification. Neocortical astrogenesis: timing, clonal articulation, molecular machineries controlling its progression.

Material provided during the course as Lecture presentations and original research articles and reviews. Suggested support book: Developmental Biology, Gilbert, 9th-11th ed.

The aim of this course is to provide the knowledge and understanding of the nervous system organization through the study of the major events of brain and spinal cord embryological development, at the genetic, molecular and cellular level.
The course provides the instruments to understand the experimental genetic approaches that are necessary to undertake neurodevelopment studies (Applying knowledge and understanding).
In addition, students are encourage to develop their critical reading of the scientific literature that will be proposed during the course (Making judgements) and that will be tested during the final assessment.
During the course, the students will be given the instruments to exploit the literature data and background together with experimental information in order to encourage their development as researchers (Learning abilities).
The presence of an oral part in the final assessment is also intended to improve students' Communication skills.

Basic knowledge of Molecular Biology, Cellular Biology and Genetics

	Traditional lectures integrated with Journal clubs discussing seminal research papers on neurodevelopmental genetics.
	Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites."
	Students will be required to take a final examination that consists of: i) a written part with 20 multiple choice questions concerning the entire programme of the course (in 1:30-hour-time); ii) a 30-minute oral interview to discuss both the written test, especially to judge the incorrect or partially incorrect answers (if any), as well as other topics addressed during the course. The final mark is assigned based on the result of the written test and on the discussion during the oral part.
	The course will address central nervous system embryonic development in vertebrate species, in particular mammals, at genetic, molecular and cellular levels. During the course, the experimental tools necessary for investigating the above topics will be also discussed. The course is given by prof. Germana Meroni and prof. Antonello Mallamaci; the contents of the course are illustrated here below. Early vertebrate development, from cleavage to gastrulation, and body axes specification. Genome editing, forward and reverse genetics, and lineage tracing tools. Neural induction and specification. In vitro modelling of pluripotent state and neural induction: ES cells, somatic reprogramming to iPS cells, SFEBq organoids. Central Nervous System patterning. Neural tube development and closure, neural crest and neural crest cells. Cerebellar histogenesis and development: specification, germinal zones, determination of cerebellar cortex layer neuronal organization and circuits, foliation and sagittal cerebellar compartmentalization. Human genetic disorders of cerebellar development and their mouse models. Rhombo-spinal domains and eye development. Elaboration of positional information along coordinate axes in the anterior brain anlage: general principles and gene effectors. Prosomeric models. Specification of the pallial field. Evolutionary conservation of CNS patterning along the coordinated axes. Neocortical neuronogenesis: generalities, pioneer neurons, glutamatergic neurons of cortical plate, interneurons. Articulation of neocortical glutamatergic neuronogenesis in rodents: proliferative layers, clonal compartments and gene machineries modulating its progression. Evolution of neocortical glutamatergic neuronogenesis: marsupials, rodents, carnivores, primates. Neocortical neuronogenesis: introduction to laminar identity specification. Neocortical astrogenesis: timing, clonal articulation, molecular machineries controlling its progression.

Testi del Syllabus

Resp. Did.	**PERIN ALESSANDRO**	**Matricola: 015060**

Docente	**PERIN ALESSANDRO, 3 CFU**

Anno offerta:	**2020/2021**
Insegnamento:	**701SM - NEUROONCOLOGY**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2020**
CFU:	**3**
Settore:	**MED/26**
Tipo Attività:	**D - A scelta dello studente**
Anno corso:	**1**
Periodo:	**Secondo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	INGLESE
Contenuti (Dipl.Sup.)	Overview about neuro-oncology (history of neuro-oncology), neuro-anatomy, epidemiology, tumor grading, tumor classification (WHO), introduction to molecular neuro-oncology, critical thinking in neuro-oncology. Overview on meningeal development and anatomy; meninges histology, histopathology; tumor subtypes, grading, treatment options, molecular features/subgroups, prognosis. Overview on hemangiopericytomas; cell of origin, histology, histopathology, grading, treatment options, molecular features, prognosis (see for instance: Armulik et al. Pericytes: Developmental, Physiological, and Pathological Perspectives, Problems, and Promises. Dev Cell 2011) Glial cell subtypes, pylocitic astrocytoma (WHO I), neurofibromatosis type I (and NF1 gene/protein), diffuse astrocytoma (WHO II), oligodendroglioma (WHO II), differences between astro- and oligodendroglioma, significance of MGMT - TP53 - 1p19q LOH - IDH, anaplastic gliomas (WHO III). See for instance Eckel-Passow et al. Glioma Groups Based on 1p/19q, IDH, and TERT Promoter Mutations in Tumors. NEJM 2015; The Cancer Genome Atlas Research Network. Comprehensive, Integrative Genomic Analysis of Diffuse Lower-Grade Gliomas. NEJM 2015; Kelderman et al. Cancer Cell 2015; Ramaswamy and Taylor. Cancer Cell 2015. Levels of evidence and clinical trials. Epidemiology, histopathology, imaging, current standard of treatment, median survival, definition of tumor progression and recurrence, definition of tumor cell, oncogenes vs. oncosuppressors, RTK - p53 - RB

	pathways in glioblastoma, hallmarks of cancer and therapeutic targets in glioblastoma, patients' stratification in clinical trials, new trends towards a better glioma histopatological/molecular/genetic classification. Brain metastases (epidemiology, risk factors, primary tumours which can give rise to brain metastases, treatments, prognosis, new perspectives). Hypothesis behind glioblastoma malignant behaviour, cancer stem cell hypothesis and its origins, from liquid to solid tumors, key-papers from Dick - Dirks - Weiss - Galli, tumor heterogeneity vs hierarchy, definition of GSC, pitfalls of this hypothesis. Evolution of the glioma stem-like cell hypothesis. Extra: how to give a good talk in science. Practical and theoretical examples of DOs and DONTs when you have to prepare and deliver a scientific presentation in front of an audience. This lesson is part of the program, since a part of the final examination will deal with that. See for instance: Alon, U. (2009) Molecular Cell 36, 165–167. History of viral therapy for GBM, viral vectors for GBM, HSV-1 for GBM, hypoxia-GBM-viral therapy, bovine viral vectors for GBM. Definition of translational research, overview on GBM in vitro and in vivo models, serum vs serum-free GBM cell cultures, in vivo models (chemically induced, mutation driven - transgenic models, isograft vs xenograft), virus mediated gene delivery for GBM.
Testi di riferimento	WHO Classification of Tumours, fourth edition (2016) IARC WHO Classification of Tumours, Louis, D.N., Ohgaki, H., Wiestler, O.D., Cavenee, W.K. IARC ISBN-13 9789283224303 ISBN-10 9283224302 Emerging Concepts in Neuro-Oncology (2013) Colin Watts (Editor) Publisher: Springer; 2013 edition (November 9, 2012) ISBN-10: 0857294571 ISBN-13: 978-0857294579 Lecture slides (provided by the teacher) along with some key papers (cited in the slides).
Obiettivi formativi	To understand the basic principles of neuro-oncology, with special regard to the genetic and molecular mechanisms involved.
Prerequisiti	None
Metodi didattici	Frontal lessons
Altre informazioni	For any doubt or for additional information: alessandro.perin@istituto-besta.it dsgubin@gmail.com
Modalità di verifica dell'apprendimento	Written examination. 4 questions + 1 (bonus) to possibly get 'magna cum laude' score. 50 minutes will be given to complete the exam
Programma esteso	Overview about neuro-oncology (history of neuro-oncology), neuro-anatomy, epidemiology, tumor grading, tumor classification (WHO), introduction to molecular neuro-oncology, critical thinking in neuro-oncology. Overview on meningeal development and anatomy; meninges histology, histopathology; tumor subtypes, grading, treatment options, molecular features/subgroups, prognosis. Overview on hemangiopericytomas; cell of origin, histology,

histopathology, grading, treatment options, molecular features, prognosis (see for instance: Armulik et al. Pericytes: Developmental, Physiological, and Pathological Perspectives, Problems, and Promises. Dev Cell 2011)

Glial cell subtypes, pylocitic astrocytoma (WHO I), neurofibromatosis type I (and NF1 gene/protein), diffuse astrocytoma (WHO II), oligodendroglioma (WHO II), differences between astro- and oligodendroglioma, significance of MGMT - TP53 - 1p19q LOH - IDH, anaplastic gliomas (WHO III). See for instance Eckel-Passow et al. Glioma Groups Based on 1p/19q, IDH, and TERT Promoter Mutations in Tumors. NEJM 2015; The Cancer Genome Atlas Research Network. Comprehensive, Integrative Genomic Analysis of Diffuse Lower-Grade Gliomas. NEJM 2015; Kelderman et al. Cancer Cell 2015; Ramaswamy and Taylor. Cancer Cell 2015.
Levels of evidence and clinical trials.

Epidemiology, histopathology, imaging, current standard of treatment, median survival, definition of tumor progression and recurrence, definition of tumor cell, oncogenes vs. oncosuppressors, RTK - p53 - RB pathways in glioblastoma, hallmarks of cancer and therapeutic targets in glioblastoma, patients' stratification in clinical trials, new trends towards a better glioma histopatological/molecular/genetic classification.

Brain metastases (epidemiology, risk factors, primary tumours which can give rise to brain metastases, treatments, prognosis, new perspectives).

Hypothesis behind glioblastoma malignant behaviour, cancer stem cell hypothesis and its origins, from liquid to solid tumors, key-papers from Dick - Dirks - Weiss - Galli, tumor heterogeneity vs hierarchy, definition of GSC, pitfalls of this hypothesis. Evolution of the glioma stem-like cell hypothesis.
Extra: how to give a good talk in science. Practical and theoretical examples of DOs and DONTs when you have to prepare and deliver a scientific presentation in front of an audience. This lesson is part of the program, since a part of the final examination will deal with that.
See for instance: Alon, U. (2009) Molecular Cell 36, 165–167.

History of viral therapy for GBM, viral vectors for GBM, HSV-1 for GBM, hypoxia-GBM-viral therapy, bovine viral vectors for GBM.
Definition of translational research, overview on GBM in vitro and in vivo models, serum vs serum-free GBM cell cultures, in vivo models (chemically induced, mutation driven - transgenic models, isograft vs xenograft), virus mediated gene delivery for GBM.

Testi in inglese

English

Overview about neuro-oncology (history of neuro-oncology), neuro-anatomy, epidemiology, tumor grading, tumor classification (WHO), introduction to molecular neuro-oncology, critical thinking in neuro-oncology.

Overview on meningeal development and anatomy; meninges histology, histopathology; tumor subtypes, grading, treatment options, molecular features/subgroups, prognosis.
Overview on hemangiopericytomas; cell of origin, histology, histopathology, grading, treatment options, molecular features, prognosis (see for instance: Armulik et al. Pericytes: Developmental, Physiological, and Pathological Perspectives, Problems, and Promises. Dev Cell 2011)

Glial cell subtypes, pylocitic astrocytoma (WHO I), neurofibromatosis type I (and NF1 gene/protein), diffuse astrocytoma (WHO II),

	oligodendroglioma (WHO II), differences between astro- and oligodendroglioma, significance of MGMT - TP53 - 1p19q LOH - IDH, anaplastic gliomas (WHO III). See for instance Eckel-Passow et al. Glioma Groups Based on 1p/19q, IDH, and TERT Promoter Mutations in Tumors. NEJM 2015; The Cancer Genome Atlas Research Network. Comprehensive, Integrative Genomic Analysis of Diffuse Lower-Grade Gliomas. NEJM 2015; Kelderman et al. Cancer Cell 2015; Ramaswamy and Taylor. Cancer Cell 2015. Levels of evidence and clinical trials. Epidemiology, histopathology, imaging, current standard of treatment, median survival, definition of tumor progression and recurrence, definition of tumor cell, oncogenes vs. oncosuppressors, RTK - p53 - RB pathways in glioblastoma, hallmarks of cancer and therapeutic targets in glioblastoma, patients' stratification in clinical trials, new trends towards a better glioma histopatological/molecular/genetic classification. Brain metastases (epidemiology, risk factors, primary tumours which can give rise to brain metastases, treatments, prognosis, new perspectives). Hypothesis behind glioblastoma malignant behaviour, cancer stem cell hypothesis and its origins, from liquid to solid tumors, key-papers from Dick - Dirks - Weiss - Galli, tumor heterogeneity vs hierarchy, definition of GSC, pitfalls of this hypothesis. Evolution of the glioma stem-like cell hypothesis. Extra: how to give a good talk in science. Practical and theoretical examples of DOs and DONTs when you have to prepare and deliver a scientific presentation in front of an audience. This lesson is part of the program, since a part of the final examination will deal with that. See for instance: Alon, U. (2009) Molecular Cell 36, 165–167. History of viral therapy for GBM, viral vectors for GBM, HSV-1 for GBM, hypoxia-GBM-viral therapy, bovine viral vectors for GBM. Definition of translational research, overview on GBM in vitro and in vivo models, serum vs serum-free GBM cell cultures, in vivo models (chemically induced, mutation driven - transgenic models, isograft vs xenograft), virus mediated gene delivery for GBM.
	WHO Classification of Tumours, fourth edition (2016) IARC WHO Classification of Tumours, Louis, D.N., Ohgaki, H., Wiestler, O.D., Cavenee, W.K. IARC ISBN-13 9789283224303 ISBN-10 9283224302 Emerging Concepts in Neuro-Oncology (2013) Colin Watts (Editor) Publisher: Springer; 2013 edition (November 9, 2012) ISBN-10: 0857294571 ISBN-13: 978-0857294579 Lecture slides (provided by the teacher) along with some key papers (cited in the slides).
	To understand the basic principles of neuro-oncology, with special regard to the genetic and molecular mechanisms involved.
	None
	Frontal lessons
	For any doubt or for additional information: alessandro.perin@istituto-besta.it dsgubin@gmail.com

	Written examination. 4 questions + 1 (bonus) to possibly get 'magna cum laude' score. 50 minutes will be given to complete the exam
	Overview about neuro-oncology (history of neuro-oncology), neuro-anatomy, epidemiology, tumor grading, tumor classification (WHO), introduction to molecular neuro-oncology, critical thinking in neuro-oncology. Overview on meningeal development and anatomy; meninges histology, histopathology; tumor subtypes, grading, treatment options, molecular features/subgroups, prognosis. Overview on hemangiopericytomas; cell of origin, histology, histopathology, grading, treatment options, molecular features, prognosis (see for instance: Armulik et al. Pericytes: Developmental, Physiological, and Pathological Perspectives, Problems, and Promises. Dev Cell 2011) Glial cell subtypes, pylocitic astrocytoma (WHO I), neurofibromatosis type I (and NF1 gene/protein), diffuse astrocytoma (WHO II), oligodendroglioma (WHO II), differences between astro- and oligodendroglioma, significance of MGMT - TP53 - 1p19q LOH - IDH, anaplastic gliomas (WHO III). See for instance Eckel-Passow et al. Glioma Groups Based on 1p/19q, IDH, and TERT Promoter Mutations in Tumors. NEJM 2015; The Cancer Genome Atlas Research Network. Comprehensive, Integrative Genomic Analysis of Diffuse Lower-Grade Gliomas. NEJM 2015; Kelderman et al. Cancer Cell 2015; Ramaswamy and Taylor. Cancer Cell 2015. Levels of evidence and clinical trials. Epidemiology, histopathology, imaging, current standard of treatment, median survival, definition of tumor progression and recurrence, definition of tumor cell, oncogenes vs. oncosuppressors, RTK - p53 - RB pathways in glioblastoma, hallmarks of cancer and therapeutic targets in glioblastoma, patients' stratification in clinical trials, new trends towards a better glioma histopatological/molecular/genetic classification. Brain metastases (epidemiology, risk factors, primary tumours which can give rise to brain metastases, treatments, prognosis, new perspectives). Hypothesis behind glioblastoma malignant behaviour, cancer stem cell hypothesis and its origins, from liquid to solid tumors, key-papers from Dick - Dirks - Weiss - Galli, tumor heterogeneity vs hierarchy, definition of GSC, pitfalls of this hypothesis. Evolution of the glioma stem-like cell hypothesis. Extra: how to give a good talk in science. Practical and theoretical examples of DOs and DONTs when you have to prepare and deliver a scientific presentation in front of an audience. This lesson is part of the program, since a part of the final examination will deal with that. See for instance: Alon, U. (2009) Molecular Cell 36, 165–167. History of viral therapy for GBM, viral vectors for GBM, HSV-1 for GBM, hypoxia-GBM-viral therapy, bovine viral vectors for GBM. Definition of translational research, overview on GBM in vitro and in vivo models, serum vs serum-free GBM cell cultures, in vivo models (chemically induced, mutation driven - transgenic models, isograft vs xenograft), virus mediated gene delivery for GBM.

Testi del Syllabus

Resp. Did.	**CESCA FABRIZIA**	**Matricola: 031484**

Docenti	**CESCA FABRIZIA, 3 CFU** **LEGNAME GIUSEPPE, 3 CFU** **MORETTI RITA, 3 CFU**
Anno offerta:	**2020/2021**
Insegnamento:	**897SM - NEUROPATOLOGIA**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2020**
CFU:	**9**
Settore:	**BIO/09**
Tipo Attività:	**B - Caratterizzante**
Anno corso:	**1**
Periodo:	**Secondo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	English
Contenuti (Dipl.Sup.)	The Neuropathology course combines core teaching of fundamental aspects of major neuropathological diseases, with emphasis on the cellular and molecular causes of neurodegeneration and their clinical presentation, and on the role of glial cells in neurodegenerative pathologies and disorders of cognition. The course will also address how hypotheses can be tested in relevant model systems and utilised to develop novel therapeutic strategies. The course contents will be organized as follows: Glial Neuropathology (prof. F. Cesca): Classification and evolution of glia and astroglia; membrane channels, receptors and transporters; ion signaling; astrocytes and brain metabolism; gliotransmission. Glial pathology: A1/A2 activated astrocytes, glial scar, Alexander disease, epilepsy, Huntington’s disease. Improved in vivo calcium imaging techniques; astrocyte-to-neuron communication in synaptic plasticity and neural circuit activity. Humanized mice; astrocytes and cognitive disorders: Rett syndrome, major depressive disorders. Molecular Neuropathology (prof. G. Legname): Molecular mechanisms in neurodegeneration; Prion diseases; Prion-like events in major neurodegenerative diseases; Proteinopathies; Protein changes in physiological and pathological conditions: Prion protein, alpha-synuclein and Lewy bodies, TDP-43, Beta-amyloid, Tau protein; Alzheimer’s Disease; Parkinson’s Disease; Creutzfeldt-Jakob Disease, Multiple Sclerosis; Bovine Spongiform Encephalopathy; Drug screening.

Clinical Neuropathology (prof. R. Moretti): Alzheimer's Disease: clinical presentation and diagnostic criteria; neuronal loss, amyloid cascade hypothesis, tau hyperphosphorilation, APOE4, altered glutamate, calcium theory; neuroinflammation; genetic hypotheses; Vascular and subcortical dementias; Movement disorders, Parkinson's disease: clinical presentation and diagnostic criteria; dopaminergic pathways; dopamine depletion: pathological and therapeutic implications; Reward mechanisms: neural circuits and neurotransmitters involved; Addiction mechanisms: neural circuits and neurotransmitters involved; Sleep and sleep disorders, dream theory; ARAS system: mono- and polysynaptic pathways; Brain death; Brain Metabolism, ischemia and its relevance in clinical practice: Apoptosis and neuroinflammation; endothelium damage; Seizure and Epilepsy.

Testi di riferimento

Verkhratsky A. and Butt A. 'Glial Physiology and Pathophysiology', Wiley-Blackwell, ISBN: 978-0-470-97853-5 (2013)

Kandel E.R et al., Principles of Neural Science, 5th Edition McGraw Hill Medical.

Aminoff. MJ .Neurology and General Medicine, Churchill and Livingsotne, 7 Ed.

Scientific articles and reviews on specific topics will also be provided during classes.
CD-ROM with slides could be provided.

Obiettivi formativi

The course seeks to provide the basic tools for the understanding of the physiopathological, symptomatological, diagnostic and therapeutic aspects of some of the most important neurodegenerative diseases, and their modeling in animals.
The feasibility of these models and the potential for translating the arising experimental data into sound clinical practice will be addressed. The lab's models will be developed in clinical practice, showing the major common sharing points and the most important differences in clinical context.

1.Knowledge and understanding: main brain pathologies starting from basic neurophysiological up to cellular and animal models arriving to clinical context, focusing on both the neuronal and glial contribution to the onset and development of the various diseases;

2. Applying knowledge and understanding: the students should be able to understand and implement experimental strategies in order to investigate specific mechanisms of different pathologies;

3. Making judgments: the students should be able to develop critical capacities to read and understand or criticize scientific papers, to organize and implement strategies to obtain or critically analyze scientific data;

4. Communication skills: students should be able to employ technical language, in order to write with major supervision a scientific paper or organize a scientific oral communication;

5. Learning skills: students should be able to organize, implement and carry on a scientific knowledge, in order to begin an experiment and with major supervision begin their steps in lab experimental sessions.

Prerequisiti

Basic knowledge in subjects such as chemistry, biochemistry, anatomy and physiology is required.

Metodi didattici	Lectures and frontal lessons. Neuroimaging, as well as electroencephalograpy will be displayed.
Altre informazioni	The material used during the lessons will be made available in moodle. Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
Modalità di verifica dell'apprendimento	Profs Cesca and Legname: students will undergo a final oral examination (mandatory), where the various issues covered in the course will be addressed and discussed. The exam may also entail the critical presentation of a scientific paper, in the form of a Journal Club, chosen by the candidate. Marks for the single modules will be attributed for a maximum of 30/30 lode. To pass the exam (18/30) the student should show sufficient knowledge of the subjects addressed during the lessons. To get the maximum score (30/30 lode) the student should demonstrate to have acquired an excellent knowledge of the topics addressed during the lessons, and a remarkable ability to expose and critically discuss the various subjects. Prof. Moretti: the evaluation will consist in 2 partial written examinations in itinere, or in a single final written examination. The examination will include 15 multiple-choice questions. Marks will be attributed for a maximum of 30/30 lode. To pass the exam (18/30), the student should answer correctly to at least 7 questions, to get the maximum score (30/30 lode) the student should answer correctly to all the questions. The final mark will be the average of the marks of the three modules.
Programma esteso	Glial Neuropathology (dr. F. Cesca): Astroglia: introduction, definition, classification, evolution. Astroglia physiology: ion channels, neurotransmitter receptors, membrane transporters. Ionic signaling: signaling of calcium, sodium, potassium, chloride, protons. Astrocytes and neuronal metabolism. Astrocytes and oxidative stress. Gliotransmission: release of neurotransmitters and neuromodulators. Neuroglia in pathology: reactive astrogliosis, astroglia degeneration, pathological remodeling of astrocytes. How to culture rodent astrocytes. A1/A2 activated astrocytes: identification, activation by microglia, proposed role in pathology. Glial scar: positive and negative functions, and still debated issues. Alexander disease: cellular and molecular features. Epilepsy: main functions of astrocytes that are altered under epileptic conditions, gliosis in epilepsy. Huntington's disease: contribution of astrocytes to the pathology. Improved in vivo calcium imaging techniques: compartmentalization of calcium signals at somas and processes, correlation with synaptic activity. Astrocytes and synaptic transmission: peri-synaptic astrocytic processes (PAPs), bi-directional communication, synaptic formation and pruning. Astrocyte activation and neural circuit activity (norepinephrine, cortical state switching, memory enhancement). Multiscale spatiotemporal integration of astrocytes with synaptic and neuronal networks. Humanized mice: applications for glial pathophysiology. Possible implications of astrocytes in cognitive disorders. Contribution of astrocytes to Rett syndrome: in vitro and in vivo evidence. Evidence of the role of astrocytes in depression disorders. Molecular Neuropathology (prof. G. Legname): Molecular mechanisms in neurodegeneration; Prion diseases; Prion-like events in major neurodegenerative diseases; Proteinopathies; Protein changes in physiological and pathological conditions: Prion protein, alpha-synuclein and Lewy bodies, TDP-43, Beta-amyloid, Tau protein; Alzheimer's Disease; Parkinson's Disease; Creutzfeldt-Jakob Disease, Multiple Sclerosis; Bovine Spongiform Encephalopathy; Drug screening. The course covers all major aspects at the molecular level of neurodegenerative diseases. Students should have a strong background in biochemistry and molecular biology. Clinical Neuropathology (prof. R. Moretti): Clinical and neuroimaging aspects of different forms of dementia, with clinical presentation and

diagnostic criteria of Alzheimer's Disease; neuropathology of neuronal loss, amyloid cascade hypothesis, tau hyperphosphorilation, APOE4, altered glutamate, calcium theory; neuroinflammation; genetic hypotheses. Vascular and subcortical dementias; principal differences and hemodynamic basis of small vessel disease. Principal common factors between AD and sVAD. Movement disorders, Parkinson's disease: clinical presentation and diagnostic criteria; dopaminergic pathways; dopamine depletion: pathological and therapeutic implications. Apoptosis and neuro-inflammation and endothelium damage. Reward mechanisms: neural circuits and neurotransmitters involved; Addiction mechanisms: neural circuits and neurotransmitters involved. Sleep and sleep disorders, dream theory; ARAS system: mono- and polysynaptic pathways; coma and Brain death. Seizure and Epilepsy.

Testi in inglese

English

The Neuropathology course combines core teaching of fundamental aspects of major neuropathological diseases, with emphasis on the cellular and molecular causes of neurodegeneration and their clinical presentation, and on the role of glial cells in neurodegenerative pathologies and disorders of cognition. The course will also address how hypotheses can be tested in relevant model systems and utilised to develop novel therapeutic strategies.
The course contents will be organized as follows:

Glial Neuropathology (prof. F. Cesca): Classification and evolution of glia and astroglia; membrane channels, receptors and transporters; ion signaling; astrocytes and brain metabolism; gliotransmission. Glial pathology: A1/A2 activated astrocytes, glial scar, Alexander disease, epilepsy, Huntington's disease. Improved in vivo calcium imaging techniques; astrocyte-to-neuron communication in synaptic plasticity and neural circuit activity. Humanized mice; astrocytes and cognitive disorders: Rett syndrome, major depressive disorders.

Molecular Neuropathology (prof. G. Legname): Molecular mechanisms in neurodegeneration; Prion diseases; Prion-like events in major neurodegenerative diseases; Proteinopathies; Protein changes in physiological and pathological conditions: Prion protein, alpha-synuclein and Lewy bodies, TDP-43, Beta-amyloid, Tau protein; Alzheimer's Disease; Parkinson's Disease; Creutzfeldt-Jakob Disease, Multiple Sclerosis; Bovine Spongiform Encephalopathy; Drug screening.

Clinical Neuropathology (prof. R. Moretti): Alzheimer's Disease: clinical presentation and diagnostic criteria; neuronal loss, amyloid cascade hypothesis, tau hyperphosphorilation, APOE4, altered glutamate, calcium theory; neuroinflammation; genetic hypotheses; Vascular and subcortical dementias; Movement disorders, Parkinson's disease: clinical presentation and diagnostic criteria; dopaminergic pathways; dopamine depletion: pathological and therapeutic implications; Reward mechanisms: neural circuits and neurotransmitters involved; Addiction mechanisms: neural circuits and neurotransmitters involved; Sleep and sleep disorders, dream theory; ARAS system: mono- and polysynaptic pathways; Brain death; Brain Metabolism, ischemia and its relevance in clinical practice: Apoptosis and neuroinflammation; endothelium damage; Seizure and Epilepsy.

Verkhratsky A. and Butt A. 'Glial Physiology and Pathophysiology', Wiley-Blackwell, ISBN: 978-0-470-97853-5 (2013)

Kandel E.R et al., Principles of Neural Science, 5th Edition McGraw Hill Medical.

Aminoff. MJ .Neurology and General Medicine, Churchill and Livingsotne, 7 Ed.

Scientific articles and reviews on specific topics will also be provided during classes.
CD-ROM with slides could be provided.

The course seeks to provide the basic tools for the understanding of the physiopathological, symptomatological, diagnostic and therapeutic aspects of some of the most important neurodegenerative diseases, and their modeling in animals.
The feasibility of these models and the potential for translating the arising experimental data into sound clinical practice will be addressed. The lab's models will be developed in clinical practice, showing the major common sharing points and the most important differences in clinical context.

1.Knowledge and understanding: main brain pathologies starting from basic neurophysiological up to cellular and animal models arriving to clinical context, focusing on both the neuronal and glial contribution to the onset and development of the various diseases;

2. Applying knowledge and understanding: the students should be able to understand and implement experimental strategies in order to investigate specific mechanisms of different pathologies;

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5. Learning skills: students should be able to organize, implement and carry on a scientific knowledge, in order to begin an experiment and with major supervision begin their steps in lab experimental sessions.

Basic knowledge in subjects such as chemistry, biochemistry, anatomy and physiology is required.

Lectures and frontal lessons.
Neuroimaging, as well as electroencephalograpy will be displayed.

The material used during the lessons will be made available in moodle.

Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.

Profs Cesca and Legname: Students will undergo a final oral examination (mandatory), where the various issues covered in the course will be addressed and discussed. The exam may also entail the critical presentation of a scientific paper, in the form of a Journal Club, chosen by the candidate. Marks for the single modules will be attributed for a maximum of 30/30 lode. To pass the exam (18/30) the student should show sufficient knowledge of the subjects addressed during the lessons. To get the maximum score (30/30 lode) the student should demonstrate to have acquired an excellent knowledge of the topics addressed during the lessons, and a remarkable ability to expose and critically discuss the various subjects.

Prof. Moretti: the evaluation will consist in 2 partial written examinations in itinere, or in a single final written examination. The examination will

include 15 multiple-choice questions. Marks will be attributed for a maximum of 30/30 lode. To pass the exam (18/30), the student should answer correctly to at least 7 questions, to get the maximum score (30/30 lode) the student should answer correctly to all the questions.

The final mark will be the average of the marks of the three modules.

Glial Neuropathology (dr. F. Cesca): Astroglia: introduction, definition, classification, evolution. Astroglia physiology: ion channels, neurotransmitter receptors, membrane transporters. Ionic signaling: signaling of calcium, sodium, potassium, chloride, protons. Astrocytes and neuronal metabolism. Astrocytes and oxidative stress. Gliotransmission: release of neurotransmitters and neuromodulators. Neuroglia in pathology: reactive astrogliosis, astroglia degeneration, pathological remodeling of astrocytes. How to culture rodent astrocytes. A1/A2 activated astrocytes: identification, activation by microglia, proposed role in pathology. Glial scar: positive and negative functions, and still debated issues. Alexander disease: cellular and molecular features. Epilepsy: main functions of astrocytes that are altered under epileptic conditions, gliosis in epilepsy. Huntington's disease: contribution of astrocytes to the pathology. Improved in vivo calcium imaging techniques: compartmentalization of calcium signals at somas and processes, correlation with synaptic activity. Astrocytes and synaptic transmission: peri-synaptic astrocytic processes (PAPs), bi-directional communication, synaptic formation and pruning. Astrocyte activation and neural circuit activity (norepinephrine, cortical state switching, memory enhancement). Multiscale spatiotemporal integration of astrocytes with synaptic and neuronal networks. Humanized mice: applications for glial pathophysiology. Possible implications of astrocytes in cognitive disorders. Contribution of astrocytes to Rett syndrome: in vitro and in vivo evidence. Evidence of the role of astrocytes in depression disorders.

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Clinical Neuropathology (prof. R. Moretti): Clinical and neuroimaging aspects of different forms of dementia, with clinical presentation and diagnostic criteria of Alzheimer's Disease; neuropathology of neuronal loss, amyloid cascade hypothesis, tau hyperphosphorilation, APOE4, altered glutamate, calcium theory; neuroinflammation; genetic hypotheses. Vascular and subcortical dementias; principal differences and hemodynamic basis of small vessel disease. Principal common factors between AD and sVAD. Movement disorders, Parkinson's disease: clinical presentation and diagnostic criteria; dopaminergic pathways; dopamine depletion: pathological and therapeutic implications. Apoptosis and neuro-inflammation and endothelium damage. Reward mechanisms: neural circuits and neurotransmitters involved; Addiction mechanisms: neural circuits and neurotransmitters involved. Sleep and sleep disorders, dream theory; ARAS system: mono- and polysynaptic pathways; coma and Brain death. Seizure and Epilepsy.

Testi del Syllabus

Resp. Did. **LODOVICHI CLAUDIA** **Matricola: 020237**

Docente **LODOVICHI CLAUDIA, 3 CFU**

Anno offerta: **2020/2021**
Insegnamento: **986SV - NEUROPHYSIOLOGY OF SENSORY SYSTEMS**
Corso di studio: **SM54 - NEUROSCIENZE**
Anno regolamento: **2020**
CFU: **3**
Settore: **BIO/09**
Tipo Attività: **D - A scelta dello studente**
Anno corso: **1**
Periodo: **Primo Semestre**
Sede: **TRIESTE**

Testi in italiano

Lingua insegnamento	ITALIANO
Contenuti (Dipl.Sup.)	Programma sintetico Il corso permette di acquisire conoscenze dei meccanismi neuronali sottesi alla percezione sensoriale, con approfondimenti di alcuni sistemi sensoriali specifici.
Testi di riferimento	Kandel ER et al. Principi di Neuroscienze; Purves D et al. Neuroscienze.
Obiettivi formativi	1.Conoscenza e comprensione: il corso si prefigge di fare acquisire allo studente gli strumenti e le competenze per affrontare lo studio delle relazioni tra funzione e struttura di sistemi ad elevato livello di integrazione, come i sistemi sensoriali. Questo tipo di competenze deve necessariamente coprire conoscenze che vanno dai meccanismi biochimici -biofisici di trasduzione dello stimolo sensoriale sino alla comprensione del sistema completo e delle modalità con cui viene codificato lo stimolo sensoriale. 2.Capacità di applicare conoscenza e comprensione: Le conoscenze e la comprensione dei contenuti del corso permettono allo studente di acquisire l'abilità di affrontare l'analisi di un sistema complesso con una prospettiva multiscala, che si può applicare a sistemi sensoriali e non. Le conoscenze acquisite permettono inoltre di affrontare criticamente la lettura di testi scientifici. Costituiscono un prerequisito fondamentale alla elaborazione e realizzazione teorica e/o sperimentale di tematiche scientifiche. 3. Autonomia di giudizio: il corso si prefigge di fare acquisire allo studente capacità critiche, di

	analisi e integrazione, necessarie per la comprensione di un sistema fisiologico complesso, multiscala. 4. Abilità comunicative: le lezioni sono intese come un momento dinamico, in cui viene sollecitato l'intervento critico degli studenti. Sarà dedicato spazio alla discussione critica degli argomenti trattati e degli articoli scientifici presentati. Questi momenti di discussione mirano a favorire le capacità comunicative e a fare acquisire un registro scientifico rigoroso e accurato. 5.capacità di apprendimento: Il corso si prefigge di fare acquisire agli studenti le competenze e la abilità di affrontare l'analisi di un sistema biologico complesso, multiscala. Questa attitudine mentale potrà essere flessibilmente impiegata per l'analisi di qualsiasi sistema complesso, integrato, multiscala, multimodale.
Prerequisiti	Meccanismi di base di neurofisiologia
Metodi didattici	Il corso si basa su lezioni frontali, nelle quali vengono affrontati e discussi i principali argomenti del programma. Durante le lezioni frontali viene stimolata e incoraggiata la discussione e l'analisi critica degli argomenti trattati da parte degli studenti attraverso il dialogo e l'utilizzo della lavagna, oltre ai mezzi didattici più moderni come videoproiettore.
Altre informazioni	Eventuali altre informazioni, sono reperibili nel sito Moodle.
Modalità di verifica dell'apprendimento	L'esame sui contenuti del programma si svolge in forma scritta e consta generalmente di una serie di domande a scelta multipla.
Programma esteso	Introduzione alla percezione sensoriale. Approfondimenti di specifici sistemi sensoriali: visivo, uditivo, olfattivo. Il sistema visivo: la retina, la trasduzione del segnale, vie e aree visive centrali. Sistema olfattivo: epitelio olfattivo, trasduzione del segnale, vie e aree olfattive centrali. Sistema uditivo: la coclea, trasduzione del segnale, vie e aree uditive centrali. Analisi di alcuni concetti chiave della fisiologia dei sistemi sensoriali, attraverso lo studio di sistemi specifici, quali, concetto di campo recettivo, topografia, elaborazione dell'informazione sensoriale, coding neuronale.

Testi in inglese

	ENGLISH
	Course contents, in brief: Knowledge of fundamental principles of the structural and functional organization of sensory systems. In depth discussion of a few sensory modalities.
	Kandel ER et al, Principles of Neuronal Sciences; Purves D et al, Neuroscience.
	1. Knowledge and comprehension of the relationship between structure and function of highly integrated systems, such as the sensory systems. This knowledge spans from the biochemical-biophysical properties of signal transduction to neuronal coding. 2. Ability to apply the acquired knowledge The contents acquired in the course endows the students with the ability to analyze complex physiological systems, in a multiscale perspective. The accomplished learning allows the critical reading of

	Notions of basic neurophysiological mechanisms
	The lectures will be given using ppt files with images, schemes, text and references to review and particularly relevant original scientific papers. The aim is to explain how (with which methods and rationale) scientists have obtained a given knowledge-mechanism. The teaching is, as much as possible, interactive, with questions to stimulate the critical participation of students and to verify their understanding of the contents being discussed.
	Other information will be available on the e-learning
	Written examination with multiple-choice questions.
	Introduction to sensory perception. Presentation of distinct sensory systems: visual, olfactory and auditory systems. The visual system: the retina, the transduction of the visual stimuli, central pathways and brain visual areas. The olfactory system: the olfactory epithelium, transduction of the olfactory stimuli, central pathways and olfactory brain areas. The auditory system: the cochlea, transduction of auditory stimuli, central pathway and brain areas. Analysis of key neurophysiological concepts such as receptive field, topographic organization, neuronal coding.

Testi del Syllabus

Resp. Did.	**BERNARDIS PAOLO**	**Matricola: 009028**

Docenti	**BERNARDIS PAOLO, 6 CFU** **CHIANDETTI CINZIA, 1 CFU**
Anno offerta:	**2020/2021**
Insegnamento:	**894SM - NEUROSCIENZE COGNITIVE**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2019**
CFU:	**7**
Settore:	**M-PSI/02**
Tipo Attività:	**C - Affine/Integrativa**
Anno corso:	**2**
Periodo:	**Primo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	English
Contenuti (Dipl.Sup.)	Course arguments:- Introduction to cognitive neuroscience - Methods of cognitive neuroscience (EEG, ERP, fMRI, TMS)- Vision (early visual processes + object and face recognition)- Attention and Space perception- Motor control (planning of movements and the dorsal stream)- Memory (Amnesia and medial temporal lobes + frontal contributions to memory and false memory)- Speech comprehension + Speech Production- Mathematical abilities- How to prepare an oral presentation.
Testi di riferimento	Main Textbook: Jamie Ward. (2015). The Student's Guide to Cognitive Neuroscience. Psychology Press: NY. 3rd edition. Prof. CHIANDETTI: The paper (mandatory): VALLORTIGARA G, CHIANDETTI C, RUGANI R, SOVRANO VA, REGOLIN L (2010). Animal Cognition. Wiley Interdisciplinar Reviews: Cognitive Science (1) 882-893 Further reading (not mandatory) in Italian only: Chapter 2 - CHIANDETTI C, DEGANO E (2017). Animali. Capacità uniche e condivise tra le specie. Mondadori Università.
Obiettivi formativi	The course is intended to provide students with a brain-based account of cognition, and a wide knowledge of the neuroscience methods. 1. Knowledge and understanding. - knowledge of basic principles, and the most up-to-date investigation techniques in the cognitive neuroscience field; - knowledge of cognitive system architecture, and theoretical models. 2. Applying knowledge and understanding.

	The students will be encouraged to propose how to apply his/her knowledge about brain anatomy and physiology to models of human cognition. Moreover, he/she will be able to understand the basic functioning principles of the most commonly used techniques cognitive neuroscience. 3. Making judgements The student will be able to have a global knowledge of the cognitive system. Particularly he/she will be able to figure out how cognitive processes can be plausibly implemented in the nervous system. 4. Communication skills. During the course the student will improve his knowledge of technical and scientific terms necessary to describe cognitive processes and psychological theories. The appropriateness of language will be assessed during the written examination. 5. Learning abilities. Learning abilities will be favored by practical laboratories on some of the experimental techniques explained during the course.
Prerequisiti	None
Metodi didattici	Theoretical lectures and workgroup
Altre informazioni	Scientific papers, web links and lessons' pdf will be given during the course, and could be downloaded from the teacher website: www.units.it/bernardis/didattica.html Prof. CHIANDETTI: Lecture presentations, links, scientific papers, and other info will be uploaded during the course on Moodle2. - Any changes, necessary to ensure the application of the safety protocols related to the COVID19 emergency, will be communicated on the Course website.
Modalità di verifica dell'apprendimento	EXAM: Written part (50%): open questions. Students should respond to the questions in 1 hour of time. Oral part (50%): Presentation of a short empirical paper to the class. Instruction on how to prepare the presentation will be given during the course.
Programma esteso	A brief summary of the brain structures, from the neuron to the highly specialized areas of the cortex. An extensive exposition of the cognitive neuroscience methods: electrophysiology, brain imaging, patients' studies, and transcranial magnetic stimulation. The main theories and findings in the fields of high- and low-level vision, space perception, human movement, mathematical abilities, and language. The course will be organized in two parts: 46 Hs of introductory theoretical lectures, 8 of which are conceived as a specific seminar dedicated to comparative cognition, and held by prof. Cinzia Chiandetti. The seminar will focus on the core knowledge hypothesis, showing how studies on non-human animals, infants and tribal populations can shed light on the existence of raw mechanisms predisposed in the brain, shared by species, and at the basis of further learning abilities in the domains of space, number, intuitive physics and psychology. The second part is devoted to students' presentation (8 Hs) of scientific papers. Each student will have to orally present to the class a scientific paper in the Journal club format. The papers will be chosen from a selection provided by the teacher during the course. Students are encouraged to use electronic presentations. The presentation is mandatory. Students, who didn't have the possibility to present the scientific paper (because abroad), must prepare a critical essay to send by email one week before the examination. For more information, contact the professor by email. The list of papers will be available during the course.

Testi in inglese

	English
	Course arguments:- Introduction to cognitive neuroscience - Methods of cognitive neuroscience (EEG, ERP, fMRI, TMS)- Vision (early visual processes + object and face recognition)- Attention and Space perception- Motor control (planning of movements and the dorsal stream)- Memory (Amnesia and medial temporal lobes + frontal contributions to memory and false memory)- Speech comprehension + Speech Production- Mathematical abilities- How to prepare an oral presentation.
	Main Textbook: Jamie Ward. (2015). The Student's Guide to Cognitive Neuroscience. Psychology Press: NY. 3rd edition. Prof. CHIANDETTI: The paper (mandatory): VALLORTIGARA G, CHIANDETTI C, RUGANI R, SOVRANO VA, REGOLIN L (2010). Animal Cognition. Wiley Interdisciplinar Reviews: Cognitive Science (1) 882-893 Further reading (not mandatory) in Italian only: Chapter 2 - CHIANDETTI C, DEGANO E (2017). Animali. Capacità uniche e condivise tra le specie. Mondadori Università.
	The course is intended to provide students with a brain-based account of cognition, and a wide knowledge of the neuroscience methods. 1. Knowledge and understanding. - knowledge of basic principles, and the most up-to-date investigation techniques in the cognitive neuroscience field; - knowledge of cognitive system architecture, and theoretical models. 2. Applying knowledge and understanding. The students will be encouraged to propose how to apply his/her knowledge about brain anatomy and physiology to models of human cognition. Moreover, he/she will be able to understand the basic functioning principles of the most commonly used techniques cognitive neuroscience. 3. Making judgements The student will be able to have a global knowledge of the cognitive system. Particularly he/she will be able to figure out how cognitive processes can be plausibly implemented in the nervous system. 4. Communication skills. During the course the student will improve his knowledge of technical and scientific terms necessary to describe cognitive processes and psychological theories. The appropriateness of language will be assessed during the written examination. 5. Learning abilities. Learning abilities will be favored by practical laboratories on some of the experimental techniques explained during the course.
	None
	Theoretical lectures and workgroup
	Scientific papers, web links and lessons' pdf will be given during the course, and could be downloaded from the teacher website: www.units.it/bernardis/didattica.html Prof. CHIANDETTI: Lecture presentations, links, scientific papers, and other info will be uploaded during the course on Moodle2. -

	Any changes, necessary to ensure the application of the safety protocols related to the COVID19 emergency, will be communicated on the Course website.
	EXAM: Written part (50%): open questions. Students should respond to the questions in 1 hour of time. Oral part (50%): Presentation of a short empirical paper to the class. Instruction on how to prepare the presentation will be given during the course.
	A brief summary of the brain structures, from the neuron to the highly specialized areas of the cortex. An extensive exposition of the cognitive neuroscience methods: electrophysiology, brain imaging, patients' studies, and transcranial magnetic stimulation. The main theories and findings in the fields of high- and low-level vision, space perception, human movement, mathematical abilities, and language. The course will be organized in two parts: 46 Hs of introductory theoretical lectures, 8 of which are conceived as a specific seminar dedicated to comparative cognition, and held by prof. Cinzia Chiandetti. The seminar will focus on the core knowledge hypothesis, showing how studies on non-human animals, infants and tribal populations can shed light on the existence of raw mechanisms predisposed in the brain, shared by species, and at the basis of further learning abilities in the domains of space, number, intuitive physics and psychology. The second part is devoted to students' presentation (8 Hs) of scientific papers. Each student will have to orally present to the class a scientific paper in the Journal club format. The papers will be chosen from a selection provided by the teacher during the course. Students are encouraged to use electronic presentations. The presentation is mandatory. Students, who didn't have the possibility to present the scientific paper (because abroad), must prepare a critical essay to send by email one week before the examination. For more information, contact the professor by email. The list of papers will be available during the course.

Testi del Syllabus

Resp. Did.	**LONGO RENATA**	**Matricola: 003135**

Docenti	**BARATELLA ELISA, 1 CFU** **CINGOLANI LORENZO ANGELO, 7 CFU** **LONGO RENATA, 2 CFU**

Anno offerta:	**2020/2021**
Insegnamento:	**895SM - TECNICHE NEUROFUNZIONALI**
Corso di studio:	**SM54 - NEUROSCIENZE**
Anno regolamento:	**2019**
CFU:	**10**
Settore:	**FIS/07**
Tipo Attività:	**C - Affine/Integrativa**
Anno corso:	**2**
Periodo:	**Primo Semestre**
Sede:	**TRIESTE**

Testi in italiano

Lingua insegnamento	English
Contenuti (Dipl.Sup.)	The course in Neurofunctional Techniques will cover both theoretical and practical aspects of the major techniques used to investigate brain function, with special emphasis on recent developments. Part 1: (prof. Renata Longo & Baratella Elisa) neuroimaging techniques Computed Tomography: basic principles, recent techniques and application in brain imaging. Magnetic resonance imaging (MRI): basic principles. Functional MRI: physical and physiological basis. fMRI experimental design: blocks and event relates paradigms data analysis in fMRI: images processing and statistical analysis Exercise in small groups at the MRI unit of the Cattinara hospital: Block design experiments, image acquisition and data analysis. Diffusion weighted images (DWI) and diffusion tensor imaging (DTI): physical basics. DTI in brain imaging: a technique for neurons bundles study Fiber tacking based on DTI data set. Exercise in small groups at the MRI unit of the Cattinara hospital: DTI experiments, image acquisition and data analysis. Radioisotopes imaging: single photon emission tomography (SPECT) and positron emission tomography (PET). Physical and physiological basics. Introduction to biological effects of ionizing radiation and radiobiology. The challenge of integration: EEG and MRI or PET, PET and CT or MRI. Part 2 (prof. Lorenzo Cingolani) Calcium imaging: We will learn how calcium imaging can be used to reveal the activity of brain networks and of subcellular compartments. We will give special emphasis to the theoretical foundations, molecular

aspects and recent achievements.

Optical approaches: We will learn about the other optical approaches used to investigate brain function, with special emphasis to those aimed at investigating synaptic vesicle release.

Electrophysiology: We will learn the theoretical and practical aspects of single cell electrophysiology with special emphasis to advanced analysis techniques.

Optogenetics and chemogenetics: we will cover both the theoretical bases and molecular aspects of optogenetics / chemogenetics. We will see how these techniques can be used in combination with electrophysiology and behavioral tests to dissect brain function.

Behavior: we will discuss the major behavioral tests used to assess brain function (motor, social and cognitive).

Statistics: we will cover the major statistical tests useful to interpret data sets in neuroscience

Testi di riferimento

The essential of functional MRI. P. W. Stroman CRC press 2011.
Handbook of Neural Activity Measurements. Romain Brette & Alain Destexhe, Cambridge University Press 2012
Ion Channels of Excitable Membranes, 3rd edition
Bertil Hille
Sinauer Associates 201
Original papers discussed and provided during lessons
Further relevant slides and pdf files will be provided during classes.

Obiettivi formativi

The aim is to provide the students with the theoretical bases necessary to interpret and design electrophysiological and imaging experiments.
Knowledge and understanding:
-Understanding the physical and physiological basis of the modern techniques used in human brain mapping;
-To understand the theoretical foundations of electrophysiology, optogenetics and imaging experiments;
-To be familiar with the practical aspects and technical constrains.
Applying knowledge and understanding:
By the end of the course the students should be able to
-design and perform an MRI study for brain mapping;
-to read critically a scientific paper that makes use of the neurofunctional techniques presented in the course;
-to choose the most suitable experimental approaches for a given scientific question.
Making judgments:
The capability to make judgments will be developed through the interaction with the lecturers during the frontal lessons, and by preparing the final examination, which requires the student to elaborate and comprehend the topics discussed over the course.
Communication skills:
The lessons will be given using the appropriate scientific language. Students will be encouraged to interact with the lecturers and among themselves to improve their scientific vocabulary, their ability to pose questions and to expose their ideas. The written examination will include some open questions in which the student will demonstrate his/her ability to elaborate the acquired knowledge, to communicate the key points in a concise and effective way. The oral examination will give students further stimuli to improve their communication skills.
Learning skills:
The ability to learn will be stimulated by studying the concepts presented during the frontal lessons, and will be assessed through the evaluation procedures described above. The students will acquire the knowledge necessary to understand the neurofunctional techniques used to investigate brain function in health and disease.

Prerequisiti	Basic knowledge of neurophysiology.
Metodi didattici	Lectures, discussion of scientific papers and small group tutorials at the MRI unit.
Altre informazioni	The material used during the lessons will be made available through the moodle platform. Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
Modalità di verifica dell'apprendimento	Part1: Students are required to take a final oral examination and to prepare a report of the MRI experiment. The oral examination consists in a discussion of 30 min, during which the student is invited to describe and comment on a few topics covered in the course. Part2: Written examination with multiple choice and open questions. Marks will be attributed to a maximum of 30/30 lode. To pass the exam (18/30), the student should answer correctly to at least 2/3 of the multiple-choice questions and 2/3 of the open questions, to get the maximum score (30/30 lode) the student should answer correctly to all the questions. The final mark will be a weighted average of parts 1 and 2
Programma esteso	Computed Tomography: basic principles, recent techniques and application in brain imaging. Magnetic resonance imaging (MRI): basic principles. Functional MRI: physical and physiological basis. fMRI experimental design: blocks and event relates paradigms data analysis in fMRI: images processing and statistical analysis Exercise in small groups at the MRI unit of the Cattinara hospital: Block design experiments, image acquisition and data analysis. Diffusion weighted images (DWI) and diffusion tensor imaging (DTI): physical basics. DTI in brain imaging: a technique for neurons bundles study Fiber tacking based on DTI data set. Exercise in small groups at the MRI unit of the Cattinara hospital: DTI experiments, image acquisition and data analysis. Radioisotopes imaging: single photon emission tomography (SPECT) and positron emission tomography (PET). Physical and physiological basics. Introduction to biological effects of ionizing radiation and radiobiology. The challenge of integration: EEG and MRI or PET, PET and CT or MRI. Introduction to the technical problems and the expected results. Calcium Imaging. Types of fluorescent calcium indicators, small molecules indicators, genetically encoded calcium indicators, intracellular calcium dynamics, calcium binding, calcium influx, calcium extrusion, calcium diffusion, general formulation of calcium dynamics, calcium-dependent fluorescence properties, fluorescence intensities, relative fluorescence change, fluorescence ratio, fluorescence lifetime, FRET efficiency, calibration of calcium indicators, simplified models of calcium dynamics, calcium microdomain model, buffered calcium diffusion, cable equation analog, single-compartment model, non-linear calcium dynamics, how to estimate the endogenous calcium binding ratio, how to quantify total calcium fluxes, how to characterize calcium-dependent processes, how to reconstruct neural spike trains. Optical imaging of synaptic vesicle release: synaptic vesicle pools and dynamics, types of fluorescent indicators for monitoring vesicle release, the alkaline trapping method: isolating exocytosis from endocytosis, optical mapping of release properties at synapses Electrophysiology. Bioelectricity: electrical potentials, electrical currents, resistors and conductors, Ohm’s law, the voltage divider, perfect and real electrical instruments, ion in solutions and electrodes, capacitors and their electrical field, currents through capacitors, current clamp and voltage clamp, glass microelectrodes and tight seals. Counting ion channels and measuring fluctuations: fluctuation of macroscopic current amplitudes as measure of the number and size of elementary units, microscopic kinetics, single channel recordings. Optogenetics and chemogenetics. Types of microbial opsins, optogenetic

tools for neuronal excitation, optogenetic tools for neuronal inhibition, chemogenetic tools for biochemical control, delivering optogenetic tools into neuronal systems, transgenic animals, developmental and layer-specific targeting, circuit targeting, light delivery and readout hardware for optogenetics, how to use optogenetics/chemogenetics to dissect the engram.

Behavioral studies in animal models of neurodevelopmental disorders. What is an animal model. Validity of an animal model: construct, face and predictive validity. Study of the face validity of an animal model: general health, motor functions , anxiety, social behavior, learning and memory. Examples of animal models of neurodevelopmental disorders: episodic ataxia, autism, epilepsy

Statistics: how to choose the correct statistical test: parametric and non-parametric statistical tests, paired and unpaired Student's t-Test, one and two-way ANOVA.

Testi in inglese

English

The course in Neurofunctional Techniques will cover both theoretical and practical aspects of the major techniques used to investigate brain function, with special emphasis on recent developments.

Part 1: (prof. Renata Longo & Baratella Elisa) neuroimaging techniques Computed Tomography: basic principles, recent techniques and application in brain imaging. Magnetic resonance imaging (MRI): basic principles. Functional MRI: physical and physiological basis. fMRI experimental design: blocks and event relates paradigms data analysis in fMRI: images processing and statistical analysis Exercise in small groups at the MRI unit of the Cattinara hospital: Block design experiments, image acquisition and data analysis. Diffusion weighted images (DWI) and diffusion tensor imaging (DTI): physical basics. DTI in brain imaging: a technique for neurons bundles study Fiber tacking based on DTI data set. Exercise in small groups at the MRI unit of the Cattinara hospital: DTI experiments, image acquisition and data analysis. Radioisotopes imaging: single photon emission tomography (SPECT) and positron emission tomography (PET). Physical and physiological basics. Introduction to biological effects of ionizing radiation and radiobiology. The challenge of integration: EEG and MRI or PET, PET and CT or MRI.

Part 2 (prof. Lorenzo Cingolani)
Calcium imaging: We will learn how calcium imaging can be used to reveal the activity of brain networks and of subcellular compartments. We will give special emphasis to the theoretical foundations, molecular aspects and recent achievements.

Optical approaches: We will learn about the other optical approaches used to investigate brain function, with special emphasis to those aimed at investigating synaptic vesicle release.

Electrophysiology: We will learn the theoretical and practical aspects of single cell electrophysiology with special emphasis to advanced analysis techniques.

Optogenetics and chemogenetics: we will cover both the theoretical bases and molecular aspects of optogenetics / chemogenetics. We will see how these techniques can be used in combination with electrophysiology and behavioral tests to dissect brain function.

	Behavior: we will discuss the major behavioral tests used to assess brain function (motor, social and cognitive). Statistics: we will cover the major statistical tests useful to interpret data sets in neuroscience
	The essential of functional MRI. P. W. Stroman CRC press 2011 Handbook of Neural Activity Measurements. Romain Brette & Alain Destexhe, Cambridge University Press 2012 Ion Channels of Excitable Membranes, 3rd edition Bertil Hille Sinauer Associates 201 Original papers discussed and provided during lessons Further relevant slides and pdf files will be provided during classes.
	The aim is to provide the students with the theoretical bases necessary to interpret and design electrophysiological and imaging experiments. Knowledge and understanding: -Understanding the physical and physiological basis of the modern techniques used in human brain mapping; -To understand the theoretical foundations of electrophysiology, optogenetics and imaging experiments; -To be familiar with the practical aspects and technical constrains. Applying knowledge and understanding: By the end of the course the students should be able to -design and perform an MRI study for brain mapping; -to read critically a scientific paper that makes use of the neurofunctional techniques presented in the course; -to choose the most suitable experimental approaches for a given scientific question. Making judgments: The capability to make judgments will be developed through the interaction with the lecturers during the frontal lessons, and by preparing the final examination, which requires the student to elaborate and comprehend the topics discussed over the course. Communication skills: The lessons will be given using the appropriate scientific language. Students will be encouraged to interact with the lecturers and among themselves to improve their scientific vocabulary, their ability to pose questions and to expose their ideas. The written examination will include some open questions in which the student will demonstrate his/her ability to elaborate the acquired knowledge, to communicate the key points in a concise and effective way. The oral examination will give students further stimuli to improve their communication skills. Learning skills: The ability to learn will be stimulated by studying the concepts presented during the frontal lessons, and will be assessed through the evaluation procedures described above. The students will acquire the knowledge necessary to understand the neurofunctional techniques used to investigate brain function in health and disease.
	Basic knowledge of neurophysiology.
	Lectures, discussion of scientific papers and small group tutorials at the MRI unit.
	The material used during the lessons will be made available through the moodle platform. Any necessary change in the course modalities due to COVID19 emergency will be published at the Department, Master Programme and Course websites.
	Part1: Students are required to take a final oral examination and to prepare a report of the MRI experiment. The oral examination consists in a discussion of 30 min, during which the student is invited to describe

and comment on a few topics covered in the course.
Part2: Written examination with multiple choice and open questions. Marks will be attributed to a maximum of 30/30 lode. To pass the exam (18/30), the student should answer correctly to at least 2/3 of the multiple-choice questions and 2/3 of the open questions, to get the maximum score (30/30 lode) the student should answer correctly to all the questions.
The final mark will be a weighted average of parts 1 and 2

Computed Tomography: basic principles, recent techniques and application in brain imaging. Magnetic resonance imaging (MRI): basic principles. Functional MRI: physical and physiological basis. fMRI experimental design: blocks and event relates paradigms data analysis in fMRI: images processing and statistical analysis Exercise in small groups at the MRI unit of the Cattinara hospital: Block design experiments, image acquisition and data analysis. Diffusion weighted images (DWI) and diffusion tensor imaging (DTI): physical basics. DTI in brain imaging: a technique for neurons bundles study Fiber tacking based on DTI data set. Exercise in small groups at the MRI unit of the Cattinara hospital: DTI experiments, image acquisition and data analysis. Radioisotopes imaging: single photon emission tomography (SPECT) and positron emission tomography (PET). Physical and physiological basics. Introduction to biological effects of ionizing radiation and radiobiology. The challenge of integration: EEG and MRI or PET, PET and CT or MRI. Introduction to the technical problems and the expected results.
Calcium Imaging. Types of fluorescent calcium indicators, small molecules indicators, genetically encoded calcium indicators, intracellular calcium dynamics, calcium binding, calcium influx, calcium extrusion, calcium diffusion, general formulation of calcium dynamics, calcium-dependent fluorescence properties, fluorescence intensities, relative fluorescence change, fluorescence ratio, fluorescence lifetime, FRET efficiency, calibration of calcium indicators, simplified models of calcium dynamics, calcium microdomain model, buffered calcium diffusion, cable equation analog, single-compartment model, non-linear calcium dynamics, how to estimate the endogenous calcium binding ratio, how to quantify total calcium fluxes, how to characterize calcium-dependent processes, how to reconstruct neural spike trains.
Optical imaging of synaptic vesicle release: synaptic vesicle pools and dynamics, types of fluorescent indicators for monitoring vesicle release, the alkaline trapping method: isolating exocytosis from endocytosis, optical mapping of release properties at synapses
Electrophysiology. Bioelectricity: electrical potentials, electrical currents, resistors and conductors, Ohm’s law, the voltage divider, perfect and real electrical instruments, ion in solutions and electrodes, capacitors and their electrical field, currents through capacitors, current clamp and voltage clamp, glass microelectrodes and tight seals.
Counting ion channels and measuring fluctuations: fluctuation of macroscopic current amplitudes as measure of the number and size of elementary units, microscopic kinetics, single channel recordings.

Optogenetics and chemogenetics. Types of microbial opsins, optogenetic tools for neuronal excitation, optogenetic tools for neuronal inhibition, chemogenetic tools for biochemical control, delivering optogenetic tools into neuronal systems, transgenic animals, developmental and layer-specific targeting, circuit targeting, light delivery and readout hardware for optogenetics, how to use optogenetics/chemogenetics to dissect the engram.
Behavioral studies in animal models of neurodevelopmental disorders. What is an animal model. Validity of an animal model: construct, face and predictive validity. Study of the face validity of an animal model: general health, motor functions , anxiety, social behavior, learning and memory. Examples of animal models of neurodevelopmental disorders: episodic ataxia, autism, epilepsy

Statistics: how to choose the correct statistical test: parametric and non-parametric statistical tests, paired and unpaired Student’s t-Test, one and two-way ANOVA.