CELLULAR NEUROBIOLOGY COURSE

Teacher Prof. Enrico Tongiorgi

HOW IS THE COURSE ORGANIZED ? CELLULAR NEUROBIOLOGY COURSE 6 Credits (Tongiorgi) 40 hours frontal teaching = 20 lessons 2-3 class exercise (group work and presentations) Time period = 1 October – ca. 22 November Evaluation = 30 (Laude)/6 Credits TECHNIQUES IN CELLULAR NEUROBIOLOGY COURSE 3 Credits (Baj) 12 hours frontal teaching = 4-6 lessons 4 Lab experiences Time period = 2 October - ca. 10 December Evaluation = 30 (Laude)/3 Credits APPLIED NEUROSCIENCE COURSE 3 Credits (Tongiorgi + 12 others) 20 hours frontal teaching = 12 teachers 4 class exercise (group work and presentations) Time period = 7– 10 January 2020 Evaluation = participation level+exercises (0; 0.5; 1 point Bonus)

HOW IS THE EXAM ORGANIZED ?

TRUE/FALSE test: one correct response is 0.45 points, each wrong response is - 0.2 LESS1. The cellular organization of the nervous system I: neurons T F 1 With the Golgi impregnation technique all neurons in a brain section are stained (no-one remains unstained) 2 According to Ramon y Cajai's neuron doctrine each neuron is an individual entity (a cell) anatomically, embryologically, and functio 3 The nervous system from an anatomical point of view is a diffuse reticular synctium 4 Thanks to the presence of electrical synapsex (gap junctions) neurons can work as a functional synctium although neurons remain as separate 5 On the basis of the classical morphological classification made by Cajal only 3.4 general types of neurons can work as described.				
7. Highly connected 8. What type of dendritic arb with a space filling arbc with a biconical samplin with a selective, single	neurons usually have wrization should a neuro rization ng arborization target restricted arbori:	a single, short and poorly ramified dendrite n have to best serve a sensory system in which a very high level of signal discrimination is required? zation		















History of neurosciences

Essentially, this theory held that the human body was filled with four basic substances, called **four humours**, which are in balance when a person is healthy.

The four humors were identified as black bile, yellow bile, phlegm, and blood.

Greeks and Romans, and the later Muslim and Western European medical establishments that adopted and adapted classical medical philosophy, believed that each of these humors would wax and wane in the body, depending on diet and activity.

When a patient was suffering from a surplus or imbalance of one fluid, then his or her personality and physical health would be affected.

This theory was closely related to the theory of the four elements: earth, fire, water and air - earth was predominantly present in the black bile, fire in the yellow bile, water in the phlegm, and all four elements were present in the blood.



Name (Arabic) Name (Latin)		Life span (AD) & contribution		Special books	City/Country	
Jurjis ibn Bakhtishu Jibril Yuhanna ibn Masawayh		700- 800	Translation from Greek and Syriac into Arabic	Translation of works of Hippocrates, Galen and Aristotle	Baghdad	
Hunain Ibn Ishak		826- 882				
Abu Zaid Ahmed ibn Sahl al- Balkhi		850- 934	Muslim psychology, medicine, neuroscience	Masalih al-Abdan wa al- anfus	Shamistiyan, Persian province of Balkh (Afghanistan)	
Al-Razi	Razes	841- 926	Internal medicine, epidemiology, ophthalmology, chemistry, physics, philosophy	Kitab Al-Mansuri (The Liber Al-Mansuris), Al-Murshid, Al-Hawi (Continents), Al-Gudari wa, Al-Gudari (de Peste or de Pestilentia)	Kharasan, Baghdad	
Abū Nasr Muhammad ibn al-Farakh al-Fārābi	Alpharabius	872- 950	Political philosophy, Epistemology, medicine	Purposes of metaphysic Translations of works of Aristotle, Focus Al- Hekam, Kitab Mabda' ara'ahl Al-Madina Al- Fadhila	Central Asia, Iran, Iraq, Syria and Egypt	
Al-Zahrawi (Abu-Al- Qasim Khalaf Ibn'Abbas Al- Zahrawi)	Abulcasis (Bucasis Alzahravius)	930- 1013	Neurosurgery	al-Tasrif Liman Ajiz 'an al' Ta'lif	Al-Andalus (Cordova)	
Abū Rayhān Muhammad ibn Ahmad Bĩrunĩ	Abu-Rayhan Biruni	937- 1048	Anthropology, pharmacology, psychology father of anthropology, geodesy and experimental mechanics, pioneer of experimental psychology	Ta'rikh al-Hind, The Mas'udi Canon, Understanding Astrology	Persia	

Ibn-Sina	Avicenna	980- 1037	Medical encyclopedia, philosophy, astronomy, poetry	100 books Al-Qanun (Canon Law) (over 1 million words)	Hamazan, Jurjan
Ibn-Rushd	Averroes	1126- 1198	Philosophy, medicine, law		Al-Andalus, Granada
Ibn-Maimon	Maimonides	1135- 1208	Philosophy, translations Hebrew & Latin, poisons, hygiene and public health	Al-Tadbir El-Sihhi, Moushid El-Hairan	Cairo (Saladdin's physician)
Ibn-Al-Nafis		1208- 1288	Pulmonary circulation, blood supply to the heart	Sharah Tashrih al Qanun, Al-Mujaz	Damascus, Cairo

Ibn Sina (Persia 980-1037)

Ibn Sina is one of the most famous Medieval Hellenistic Muslim philosophers, who wrote approximately 99 books throughout his lifetime on philosophy, religion, poetry, and memory (Islamic Philosophy Online, 2011).

In the Golden Age of Islam, the validity of Galenic theory started being questioned by three notable scholars. While ibn Sina, ibn al-Nafis, and ibn al-Haytham began arguments against Galen's anatomic theory, widespread skepticism did not begin until the 16th century in Europe.

Ibn Sina places logic and reasoning abilities in the category of mental functioning. He believed that sensation and perception are factors of memory. Conceptualizing theories requires the use of manipulating memories in order to understand the concept. With this idea, Ibn Sina almost equates imagination to intellectual ability.

A father of modern neuroscience ibn Sina (Avicenna) 980-1037

















































Similarities and differences between the nervous systems of invertebrates and vertebrates				
Invertebrate nervous systems	Vertebrate nervous systems			
Motor neurons and interneurons typically unipolar	Motor neurons and interneurons typically multipolar			
Neuronal somata in rind or ganglia	Neuronal somata typically grouped in			
Dendritic processes arise directly from axons	ganglia			
in most cases	Dendritic processes arise from soma			
Synapses in neuropil	Several distinct types of glia			
Few types glia				
Lack myelin	conduction			
Large cells in many instances	Few cells that are very large			
Individually identifiable in many instances	Few individually identified neurons			
Neural circuits have relatively few neurons	Neural circuits have many components			





What general class of neuron?































What changes a	nong the dendrites ?
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Neuron	Average soma diameter (μm)	Number of dendrites at soma	Proximal dendrite diameter (μm)	Number of branch points	Distal dendrite diameter (µm)	Dendrite extent* (µm)	Total dendritic length (μm)
Cerebellar granule cell (cat)	7	4	1	0	0.2-2	15	60
Starburst amacrine cell (rhesus)	9	1	1	40	0.2-2	120	_
Dentate gyrus granule cell (rat)	14	2	3	14	0.5-1	300	3200
CA1 pyramidal cell (rat)	21						11900
basal dendrites		5	1	30	0.5-1	130	5500
stratum radiatum		1	3	30	0.25-1	110	4100
stratum lacunosum-molecula	ire			15	0.25-1	500	2300
Cerebellar Purkinje cell (guinea pig)	25	1	3	440	0.8-2.2	200	9100
Principal cell of globus pallidus (human)	33	4	4	12	0.3-0.5	1000	7600
Meynert cell of visual cortex (macaque)	35						15400
basal dendrites		5	3		_	250	10200
apical dendrites		1	4	15	2–3	1800	5200
spinal α-motoneuron (cat)	58	11	8	120	0.5-1.5	1100	52000

*The average distance from the cell body to the tips of the longest dendrites.

Sources: Ito (1984); Mariani (1990); Claiborne et al. (1990); Bannister and Larkman (1995a); Rapp et al. (1994); Palay (1978); Yelnik et al. (1984); Ulfhake and Kellerth (1981).









Summary

- Historical background of the neuronal theory
- Neuronal theory (Golgi & Cajal)
- Polarity of neurons (imperfect epithelial similarity)
- Comparison between unipolar, multipolar neurons
- · Diversity of neurons: dimensions, myelin, spines
- Diversity of neurons: dendrites, different shape reflect different function,
- Evolution: not all neurons show scaling with increasing brain size