Neuroscience Course Learning Objectives

Medical Knowledge
The student will be able to discuss and utilize clinically the following facts and concepts:

BRAIN OVERVIEW (CSF, MENINGES, AND BLOOD-BRAIN BARRIER)
1. the location of the following brain regions: medulla, pons, midbrain, cerebellum, thalamus, hypothalamus, cerebral cortex, superior colliculus, inferior colliculus, pituitary, and pineal
2. the vessels that comprise the anterior circulation
3. the vessels that comprise the posterior circulation
4. the major elements of the ventricular system of the brain
5. formation of CSF
6. the pathway of CSF circulation
7. the structure and function of the three meninges (dura mater, pia mater, arachnoid)
8. the blood-brain barrier
9. the property that determines whether substances cross the blood-brain barrier

CIRCULATION
10. the vessels give rise to the posterior circulation
11. the main vessels supplying the medulla
12. the main vessels supplying the pons
13. the main vessels supplying the midbrain
14. the vessels giving rise to the anterior circulation
15. the vessel giving rise to the anterior cerebral artery
16. the region of cortex supplied by the anterior cerebral artery
17. the vessel giving rise to the middle cerebral artery
18. the region of cortex supplied by the middle cerebral artery supply
19. the vessel giving rise to the posterior cerebral artery
20. the region of cortex supplied by the posterior cerebral artery supply
21. the vessel giving rise to the anterior cerebral artery
22. the region of cortex supplied by the anterior cerebral artery supply
23. the vessels comprising the circle of Willis

DEVELOPMENT
24. the anatomical orientation and terminology of dorsal:ventral, medial:lateral, anterior:posterior, and rostral:caudal
25. the origin of the nervous system from the trilaminar embryonic stage
26. the general concepts of nervous system organization polarity, bilateral asymmetry, and regionalization
27. the somites and what they differentiate into
28. the mean of the terms “general somatic afferent” and “general somatic efferent”
29. the 3 original brain vesicles in terms of their adult counterparts
30. the development of the ventricular system and relationship to the brain vesicles
31. the origin of gray and white matter
32. the orientation of sensory and motor components of the spinal cord and how that orientation changes in the brainstem
33. the features that distinguish neural epithelium from neural crest
34. the derivatives of the neural crest
35. the relation of spina bifida to the neural tube

NEUROHISTOLOGY
36. the origin of the neural epithelium and its cellular derivatives
37. the unique cell biology of neurons and the Neuron Doctrine
38. the various classifications of neurons
39. the various types of synapses
40. the structure and function of the astrocyte
41. the structure and function of the microglia cell
42. the structure and function of the oligodendrocyte
43. the similarities and differences of the oligodendrocyte and the Schwann cell
44. the differences between: tract vs. nerve, and ganglion vs. nucleus
45. the concept of "stem cell"

NEURON ELECTROPHYSIOLOGY and SYNAPTIC TRANSMISSION
46. the ionic basis of the resting membrane potential
47. the ion channel is most important for determining the resting membrane potential
48. the sequence of ionic currents that occur during the action potential
49. the ion channels that are important during the action potential
50. the part of the neuron normally first to generate an action potential
51. the events that occur during propagation of the action potential
52. the meaning of saltatory conduction of the action potential
53. the function of the myelin sheath in a myelinated axon
54. the relation of axonal sodium channels to the myelin sheath
55. the neurotransmitter at the neuromuscular junction
56. the events that occur during synaptic transmission at the neuromuscular junction
57. the function of synaptic vesicles
58. the ion critical for release of neurotransmitter during synaptic transmission
59. the abnormality of synaptic transmission in myasthenia gravis
60. how glutamate acts as a neurotransmitter
61. how GABA acts as a neurotransmitter
62. the ion critical at inhibitory synapses
63. the meaning of ligand-gated ion channels
64. the meaning of spatial summation and temporal summation
65. post-tetanic potentiation
66. presynaptic inhibition
67. how botulinum toxin affects synaptic transmission
68. how tetanus toxin affects synaptic transmission
69. how black widow spider toxin affects synaptic transmission
70. how electrical synapses function
CHANNELOPATHIES
71. the basic mechanism that causes ion channel dysfunction in human diseases
72. how the malfunction in one or more of the basic properties of an ion channel in neurons or skeletal muscle fibers explains pathologies of the neuromuscular system
73. the conceptual basis of drugs in improving symptoms of a malfunctioning channel
74. in myotonia what are the basic relationships between channel dysfunction, action potential alteration, synaptic transmission, and general patient symptoms
75. in Lambert-Eaton syndrome what are the basic relationships between channel dysfunction, action potential alteration, synaptic transmission, and general patient symptoms
76. in myotonia what are the basic relationships between channel dysfunction, action potential alteration, synaptic transmission, and general patient symptoms
77. the inherent difficulties in extrapolating the behavior of an ion channel in an in vitro system to a nerve cell in the middle of a complex network of neurons

SPINAL CORD ANATOMY/ASCENDING SYSTEMS, Michael F. Dauzvardis, PhD
78. the relation between vertebral column and spinal cord level numbering
79. the relation between spinal cord and peripheral nerve meninges
80. what distinguishes a dermatomal from a peripheral nerve sensory loss
81. the major nuclei in the spinal cord gray matter
82. the meaning of slow and rapid adapting receptors
83. what receptors are associated with touch and pain/temperature
84. the origin, course and termination of ascending pathways related to touch, pain, temperature and also the cerebellar ascending pathways
85. the origin, course and termination of the ascending pathways related to touch and proprioception
86. the origin, course and termination of the ascending pathways related to pain, temperature
87. the origin, course and termination of the two ascending pathways related to the cerebellum
88. deficits are associated with lesions of each of the ascending pathways
89. the sensory deficits in Brown-Sequard Syndrome
90. the Romberg sign

ASCENDING SYSTEMS CONTINUED/DESCENDING SYSTEMS, Michael F.
91. the definition of a motor unit
92. how spinal motor neurons are organized somatotopically
93. the difference between alpha motoneurons and gamma motoneurons
94. the appearance of the ventral horn at various levels of the spinal cord
95. the course of the corticospinal tract
96. the course of the rubrospinal tract
97. the course of the reticulospinal tract
98. the course of the vestibulospinal tract
99. the course of the tectospinal tract
100. where he various descending tracts run in the white matter of the spinal cord (what
funiculus)
101. what descending tracts are crossed and where they cross
102. the difference between “upper motor neurons” and “lower motor neurons”
103. the pathway degenerates after a stroke affecting the cerebral motor cortex
104. how amyotrophic lateral sclerosis (ALS) affect the brain
105. the difference between “lateral motor system” the “medial motor system”

SKELETAL MUSCLE & SPINAL CONTROL (I & II), Erika Piedras-Renteria, PhD
106. the effects of denervation on skeletal muscle
107. the advantages of the motor pool for neural control of skeletal muscle
108. the definition of neurogenic diseases and examples
109. the type of stimulus sensed by the muscle spindle
110. the type of stimulus sensed by the Golgi tendon Organ (GTO)
111. the muscle that is the target of gamma motoneurons
112. the meaning of the presence of Moro and Tonic neck reflexes
113. the function of the stretch reflex
114. the function of the GTO reflex
115. recurrent inhibition
116. hyporeflexia with examples
117. hyporeflexia with examples

CLINICAL CORRELATION: SPINAL CORD DISORDERS
118. the concepts of upper and lower motor neuron syndromes and how they apply to
lesions of the spinal cord at cervical, thoracic and lumbosacral levels
119. the signs and symptoms of radiculopathy at typical root levels and their
pathophysiological basis
120. the concept of radicular “root” pain, and how clinical assessment of dermatomes is
done
121. the sensory signs and symptoms associated with lesions of the spinothalamic and
posterior column pathways in both extramedullary and intramedullary spinal cord
lesions
122. the typical clinical presentation, pathophysiology, and diseases associated with
various spinal cord syndromes, such as transverse myelopathy, syringomyelia, anterior
spinal artery occlusion, subacute combined degeneration, amyotrophic lateral sclerosis,
tabes dorsalis, and Brown-Sequard hemicord syndromes
123. the setting, signs, and symptoms of “spinal shock”

CLINICAL CORRELATION: NEUROMUSCULAR DISORDERS, Michael Merchut, MD
124. the normal physiology at the neuromuscular junction (NMJ)
125. the NMJ pathophysiology involved in myasthenia gravis (MG) and Lambert-Eaton
myasthenic syndrome (LEMS)
126. the signs and symptoms of MG, including the most common
127. the distinction between ocular vs. generalized MG
128. how the diagnosis of MG and LEMS made
129. the role of the thymus in MG
130. the various treatments for MG and LEMS
131. the effect of anticholinesterase medication at the NMJ
132. How to recognize and treat a clinical crisis in MG
133. the definition of Which sensations are exteroceptive, proprioceptive, and secondary (cortical)
134. how these sensory modalities are tested clinically in patients
135. how these sensory modalities relate to their anatomical pathways and nuclei
136. the pattern of sensory deficit in amononeuropathy, polyneuropathy, radiculopathy (dermatomal), myelopathy (extramedullary and intramedullary spinal cord lesions), thalamic lesion, and parietal (cortical) lesion
137. the afferent-efferent circuit is assessed with muscle stretch reflex (MSR)
138. how the muscle stretch reflexes tested clinically (biceps, triceps, brachioradialis, knee, and ankle reflexes), how are they elicited and graded (0-4), and what are the spinal levels or roots they represent
139. the meaning of a pattern of abnormal MSRs in which right side hyper-reflexia is found
140. the meaning of clonus
141. how superficial reflexes are commonly tested, how they are elicited, and what cranial nerves are involved with each
142. why superficial reflexes are consensual
143. the significance of pathological reflexes, especially the description and method of eliciting the Babinski sign

BRAIN STEM (MEDULLA, PONS, MIDBRAIN, TRIGEMINAL AUDITORY, PATHS TO CORTEX)
144. the difference between general somatic efferent (GSE) and special visceral efferent (SVE) fibers
145. the difference between general somatic afferent (GSA) and general visceral afferent (GVA) fibers
146. the definition of special visceral afferent (SVA) fibers and where they terminate in the brain stem
147. the locations of in the brainstem of the alar plate, the basal plate, and the sulcus limitans
148. where all cranial nerve visceral afferents terminate in the brain stem
149. the components of the vagus nerve
150. the components of the glossopharyngeal nerve
151. the components of the facial nerve
152. the components of the trigeminal nerve
153. what is unusual about the mesencephalic trigeminal nucleus and what reflex depends on it
154. where the trigeminal-thalamic tract terminates
155. the cranial nerve nuclei that innervate the extraocular muscles
156. the small but critical fiber pathway integrates activity of the cranial nerve nuclei innervating extraocular muscles
157. the PPRF and its function in lateral gaze paralysis
158. cranial nerves involved in the pupillary light reflex
159. the main elements of the auditory pathway as it ascends through the brain stem to the thalamus
160. what happens to vestibular afferents in brain stem
161. the circuit of the vestibulo-ocular reflex (“VOR”)
162. the two critical pathway crossings take place in the lower medulla
163. the location of the inferior olive, where it projects, and how it gets there
164. the hypothalamic-autonomic (“descending sympathetic”) tract
165. the nucleus in the medulla that is a critical element of the brain stem’s respiratory center
166. the importance of the locus ceruleus and the raphe nuclei and at what level of the brain stem they are located
167. the importance of the pontine gray, where it projects, and how it gets there
168. what happens to the fasciculus gracilis and fasciculus cuneatus in the medulla
169. what happens to the dorsal and ventral spinocerebellar tracts in the brain stem
170. the source of superior cerebellar peduncle
171. the importance of substantia nigra in midbrain
172. the brain stem structure that is a critical element of the orienting reflex to visual, auditory, and tactile stimuli
173. where the tectospinal tract originates
174. the function of the periaqueductal gray in pain
175. the level of the brain stem where the red nucleus is found and its importance
176. the difference between the cerebral peduncle and the cerebellar peduncles
177. the symptoms of the lateral medullary syndrome (Wallenberg) and how each symptom is related to damage of specific tracts or nuclei in the brain stem
178. the circuitry of the baroreflex, the corneal reflex, the cough reflex, the gag reflex, the papillary light reflex, and the jaw closing reflex

VESTIBULAR SYSTEMS I & II
179. the structure and function of the otolithic organs, semicircular canals, and sensory receptors
180. the vestibular pathways in the nervous system, the primary afferent vestibular projections, the origins of vestibulospinal pathways, and vestibular inputs to the cerebellum
181. the clinical aspects of balance disorders, vestibular compensation, tests of the vestibular system, and the pathway involved in a reflex righting movements (“slip on the ice”)
182. the ocular pathways concerned with conjugate eye movements, role of the PPRF, MLF and frontal eye fields
183. nystagmus, the doll’s eye maneuver, internuclear ophthalmoplegia, and the vestibuloocular reflex

PATHS TO CORTEX
184. where the thalamus is located
185. which thalamic nucleus relays medial lemniscal inputs to the somatosensory cortex
186. which thalamic nucleus relays trigemino-thalamic inputs to the somatosensory cortex
187. where the somatosensory cortex is located (gyrus, lobe, Brodmann numbers, nearby sulcus)
188. which thalamic nucleus relays the auditory pathway to the auditory cortex
189. where the auditory cortex is located (gyrus, lobe, Brodmann numbers, sulcus nearby)
190. which thalamic nucleus relays visual optic tract information to the visual cortex
191. where the visual cortex is located (gyrus, lobe, Brodmann numbers, sulcus)
192. how many layers of cells and fibers are in the cerebral cortex

EYE MOVEMENTS
193. the muscles and the nerves responsible for opening and closing the eyelids
194. the differences between pupillary and accommodation reflexes
195. muscles and the nerves are responsible for the six cardinal directions of gaze
196. the various types of eye movements
197. the nerve/muscle deficits based on abnormal eye movements

RETICULAR FORMATION
198. the major organizational divisions and functions of the reticular formation
199. the ascending reticular activating system and how it relates to sleep-wake cycles and to understanding the difference between sleep and coma
200. the neurotransmitter associated with the raphe nuclei
201. the neurotransmitter associated with the locus ceruleus
202. the brain stem nuclei that have neurons with opiate receptors and how they might be involved in pain modulation
203. the oculosympathetic pathway and how its dysfunction leads to a constellation of clinical findings referred to as Horner's syndrome

CEREBELLUM I & II
204. the location of the cerebellar vermis, cerebellar hemispheres, anterior lobe, posterior lobe, and flocculonodular lobe
205. what a folium is
206. the definition of mossy fibers
207. the definition of climbing fibers
208. what runs in the inferior cerebellar peduncle
209. what runs in the middle cerebellar peduncle
210. what runs in the superior cerebellar peduncle
211. where the deep cerebellar nuclei are located and what pathway they give rise to
212. the three arteries supply the cerebellum on each side
213. the function of vestibulocerebellum (flocculonodular lobe)
214. the function of spinocerebellum
215. the function of neocerebellum
216. the somatotopic organization of cerebellum
217. the basic cerebellar circuitry involving among mossy fibers, climbing fibers, granule cells, Purkinje cells, and deep cerebellar nuclei
CLINICAL CORRELATION: CRANIAL NERVES
218. the signs and symptoms associated with lesions of each of the cranial nerves
219. how the cranial nerves are tested clinically
220. the basis for the pupillary light reflex and near reflex
221. the abnormal state of the pupil in lesions of the optic vs. oculomotor nerves, sympathetic vs. parasympathetic denervation and dissociation of light and near reflex
222. the interactions of brain stem and cerebellum with cranial nerve nuclei responsible for normal eye movement, especially the medial longitudinal fasciculus (MLF)
223. the signs and symptoms associated with pathological eye movements, including diplopia, nystagmus and the MLF syndrome, and their underlying lesions
224. the clinical syndrome of trigeminal neuralgia, its causes and treatments
225. the anatomical correlates of upper motor neuron vs. lower motor neuron lesions causing facial paralysis
226. the clinical syndrome of Bell's palsy, and other lesions along the course of the facial nerve
227. the clinical deficits from lesions of cranial nerves and pathways (e.g., spinothalamic, corticospinal tracts) and how do they localize the pathology to a specific level or area within the brain stem, especially the medullary and midbrain syndromes of Wallenberg and Weber, respectively

CLINICAL NEUROANATOMY: TOUR OF THE POSTERIOR FOSSA
228. the elements of the patient history that localize symptoms to structures in the posterior fossa
229. some of the pathological mechanisms that are associated with specific posterior fossa clinical Syndromes.
230. For each of the four cases presented, what is the most likely pathology (e.g., tumor, stroke syndrome, degenerative disease, trauma, infection) based on the tempo and severity of the signs and symptoms
231. the utility of neuroimaging (radiographs, CT, MRI) with respect to diagnosis and begin to interpret radiological abnormalities

AUTONOMIC NERVOUS SYSTEM I & II,
232. the neurotransmitter released from pre- and post-ganglionic neurons and the types of postsynaptic potentials that can be generated by each
233. the relative degree of myelination of the pre- and post-ganglionic neurons and how this influences neurotransmission of the autonomic signal
234. the approximate ratio between pre- and post-ganglionic fibers of the different systems and how this influences the response to their activation
235. the characteristics of the autonomic neuro-effector junction and how this influences the response to activation of the autonomic system
236. For the following ganglia, the origin of the pre-ganglionic fibers that innervate them, the target organs they innervate, and the response of the target organ when the specific ganglion is stimulated superior cervical ganglion, middle cervical ganglion, stellate ganglion, celiac ganglion, superior mesenteric ganglion, inferior mesenteric ganglion
237. Likewise for the following organs, the sympathetic ganglia that innervate them and the approximate spinal cord levels that contribute to their sympathetic-mediated response: tarsal muscle, iris muscle, salivary gland, lungs, heart, stomach and small intestines, spleen, liver and pancreas, adrenal medulla, colon, head and neck sweat glands and blood vessels, glands and blood vessels of the upper extremity and chest, sweat glands and blood vessels of the lower chest and abdomen, sweat glands and blood vessels of the lower extremities.

238. The distinguishing characteristics of the route of pre- and post-ganglionic sympathetic innervations of the following targets: skin and muscle, thoracic viscera, abdominal viscera and genitalia, adrenal medulla, lower extremities, head and neck (upper parts of arm and shoulder; lower neck; upper neck, head and eye).

239. For the following parasympathetic central nervous system cell bodies that give rise to preganglionic sympathetic fibers, what are the ganglia they innervate, the effector organ innervated by their associated ganglia and the effector response of the organ elicited by ganglion stimulation: Edinger-Westphal nucleus, lacrimal nucleus, superior salivatory nucleus, inferior salivatory nucleus, dorsal motor nucleus, nucleus ambiguous, intermedial spinal gray of S2-S4.

240. The main receptor subtype(s) that mediate the following autonomic-induced organ responses: blood vessel constriction and dilation, pupillary constriction and dilation, GI sphincter and uterus constriction and relaxation, decreased and increased GI motility, activation of apocrine sweat glands, increased liver glucose production, inhibition of noradrenaline release from nerve terminals, increased and decreased inotropy, chronotropy and contractility of the heart, increased renin release, increased lipolysis, bronchiolar dilation or constriction, myenteric plexus activation, ciliary muscle contraction, bladder detrusor muscle contraction, stimulation of eccrine sweat glands, tear glands, salivary glands, stimulation of pancreatic digestive fluids, liver and bile items.

241. The stellate, middle, and superior cervical ganglia and the pathways and projection targets of their pre and post-ganglionic neurons.

242. The origin of pre-ganglionic parasympathetic neurons and their respective targets.

243. The nuclei that are depicted in the drawing and their relative location to one another as well as their target projections within the parasympathetic system.

244. The autonomic reflexes are involved in the following clinical findings: hypertensive crisis from bladder distension in individuals with chronic spinal cord lesion, sweating of the skin, syncope during standing in patients with chronic peripheral neuropathy of the autonomic nerves.

Cortex I and II

245. How many cellular layers are typically found in the cerebral cortex?

246. The connections of each cortical layer.

247. The basis of Brodmann’s cytoarchitectonic divisions.

248. What cortex is supplied by middle cerebral artery, anterior cerebral artery, and posterior cerebral artery.

249. The origin and location of the corpus callosum and anterior commissure.

250. The internal capsule its subdivisions.

251. The five major categories of cortical function.

252. The basic organization of somatosensory cortex.
253. how many body maps are found in somatosensory cortex
254. the basic organization of motor cortex
255. where primary auditory cortex located
256. what feature of sound are auditory cortex neurons tuned to
257. the location of primary visual cortex
258. how peripheral visual fields map onto primary visual cortex
259. the definition of a hypercolumn, an ocular dominance column, an orientation column, and an orientation “pinwheel” in primary visual cortex
260. the dorsal and ventral streams of visual processing and what each does
261. the definition of blindsight
262. the symptoms of prosopagnosia
263. where Wernicke’s area and Broca’s area are located
264. the symptoms of two major types of aphasia
265. the are of frontal cortex related to eye movements and attention
266. the cortex of frontal cortex related to visceral autonomic responses and emotion

CLINICAL CORRELATION: LANGUAGE
267. the basic elements of speech and language and how you distinguish one from the other
268. the various aspects of language and how you clinically test them, including fluency, comprehension, paraphasic errors, naming and repetition
269. how you recognize the common types of aphasia (Broca, Wernicke, conductive and global) and their anatomical correlates
270. the meaning of prosody and aprosodia

CLINICAL CORRELATION: MULTIPLE SCLEROSIS
271. the general concept of multiple sclerosis (MS) as an autoimmune, demyelinating disorder of the central nervous system
272. Regarding the pathophysiology of MS, what are the currently accepted hypothesis and clinical risk factors for acquiring MS (age, gender, family history, geography)
273. the signs and symptoms typically associated with MS, including Lhermittes sign, trigeminal neuralgia, optic neuritis and internuclear ophthalmoplegia
274. the criteria for the clinical diagnosis of MS, and its associated difficulty
275. laboratory testing which supports the clinical diagnosis of MS, and which is most sensitive
276. the clinical course and progression of MS, including indications for various treatments

IMAGING OF THE BRAIN & ITS VASCULATURE
277. the brief history behind the development of the science of radiographic imaging
278. how has less invasive imaging superseded the older, more invasive techniques
279. the basic principles behind X-Ray, angiogram, nuclear isotope, computerized tomography, and magnetic resonance imaging
280. the appearance of blood, ventricular obstruction, edema, and midline shift on CT and MRI scans
281. the respective advantages of X-Rays, angiograms, computerized tomography, ultrasound, nuclear isotope, and magnetic resonance imaging
282. the risks of X-rays, angiograms, computerized tomography, ultrasound, nuclear isotope, and magnetic resonance imaging

DIENCEPHALON
283. what thalamic nucleus relays medial lemniscal inputs to cortex and it projects in cortex
284. what thalamic nucleus relays trigeminal inputs to the cortex and where it projects in cortex
285. what thalamic nucleus relays visual inputs to cortex and where it projects in cortex
286. what thalamic nucleus relays auditory inputs to cortex and where it projects in cortex
287. what thalamic nucleus relays cerebellar inputs to cortex where it projects in cortex
288. what thalamic nucleus relays basal ganglia inputs to the cortex and where it projects in cortex
289. what thalamic nucleus projects to the lateral (eyes-head/attention) prefrontal cortex and to the medial/orbital (autonomic/emotion) cortex
290. the location of the internal medullary lamina and the intralaminar nuclei

COMA
291. the definition of coma
292. brain lesions cause coma
293. metabolic causes of coma
294. the definition of consciousness
295. the definition of brain death and how it is determined
296. the definition of death and how it is determined
297. the explanation of: “You are not dead until you are warm and dead.”

BASAL GANGLIA
298. which nuclei compose the basal ganglia
299. what two nuclei comprise the striatum
300. what nucleus provides dopaminergic innervation of the striatum
301. the effect of the “direct pathway” on movement
302. the effect of the “indirect pathway” on movement
303. what thalamic nucleus is primary target of basal ganglia output
304. the symptoms of Parkinsons disease and how they are related to direct and indirect pathway theory
305. the cause of Parkinsons disease
306. the standard pharmacotherapy for Parkinsons disease
307. the basis for deep brain stimulation therapy for Parkinson’s disease and what basal ganglia structure is the target of DBS
308. the cause of Huntingtons disease and how is it related to direct and indirect pathway theory; what huntingtin is 309. hemiballismus and its cause
310. what mental illness treated with dopaminergic receptor blocking drugs such as haloperidol
311. the concept of the ventral striatal system, the source of its dopaminergic input, what thalamic nucleus is it primary target, and where this thalamic nucleus projects in cortex

CLINICAL CORRELATION: GAIT, CEREBELLAR&MOVEMENT DISORDERS
312. the basic elements necessary for normal gait and station
313. the Romberg sign, its significance, and how you perform it
314. the following abnormal gait patterns and their pathophysiological basis: ataxic, hemiplegic, tabetic, steppage, duck waddle (myopathic), scissors (spastic), and parkinsonian gaits
315. the clinical signs and symptoms of cerebellar dysfunction, and how you test for them, including dysmetria, tremor, dysdiadochokinesia, rebound phenomena (loss of check response), dysarthria and nystagmus
316. the vermic vs. hemispheral cerebellar syndromes and how you distinguish them
317. the spinocerebellar degenerations or ataxias
318. the different types of tremor and associated disorders
319. the different types of spontaneous movement disorders, and the associated anatomical lesions where known, including tremor, choreoathetosis, hemiballismus, dystonia, tic, myoclonus, and asterixis
320. common pharmacological treatments of these movement disorders

BRAIN IMAGING ESSENTIALS
321. the basic methods by which CT and MRI scans are created
322. the advantages versus disadvantages for CT and MRI
323. the typical findings for: hemorrhage ischemic infarction edema multiple sclerosis brain tumor

END-OF-LIFE ISSUES IN NEUROLOGY
324. the dual role of medicine related to end-of-life issues
325. the common issues or symptoms encountered in dementia, persistent vegetative state, and amyotrophic lateral sclerosis, and the treatment options available
326. the basic skills required in palliative or end-of-life care

MOTOR SYSTEMS, Edward J. Neafsey, PhD
327. the components of the motor servo
328. the overall function of the motor servo and what muscle property it controls
329. the physical device the motor servo makes muscle behave like
330. what a central pattern generator is how a CPG is involved in walking
331. the descending motor pathways that preferentially control distal muscles of limbs
332. the descending motor pathways that preferentially control axial and proximal muscles
333. the definition and causes of spasticity
334. the basis of transcortical (“long loop”) stretch reflexes
335. the brain systems important in early planning and programming of movements
336. how movements in cerebellar or basal ganglia disease differ from movements in normal subjects
HYPOTHALAMUS 1 & 2
337. how the hypothalamus is involved in homeostasis
338. how the hypothalamus is involved in reproduction
339. how the hypothalamus is involved in motivated behaviors or drives such as the 4 F’s
340. the changes in the hypothalamus in evolution: large or small?
341. the anatomical organization of the hypothalamus
342. the main hypothalamic nuclei and how are they connected with the rest of the brain
343. how the hypothalamus participates in control of circadian rhythms
344. how the hypothalamus relates to the pituitary
345. what functions are regulated or modulated by the hypothalamus
346. how the hypothalamus is sexually dimorphic
347. the classical hypophysiotropic (hypothalamic releasing) hormones, their general characteristics, and the main function of each in pituitary secretion
348. how the hypothalamus regulates reproductive behavior and neuroendocrine function
349. the hypothesized role of the preoptic area in generation of fever
350. what part of the hypothalamus is considered the body’s “clock” and how the clock is entrained
351. the multiple roles of the paraventricular nucleus (the “head ganglion” of the autonomic nervous system)
352. which hypothalamic nuclei are referred to as “feeding” and “satiety” centers, and what is the importance of these brain regions in regulation of energy balance, feeding behavior and macronutrient selection
353. the neurotransmitters/peptides that are orexigenic vs anorexigenic
354. how the hypothalamus is important in many clinically relevant, serious, and sometimes just plain annoying, conditions, including generation of fever, stress, jet lag, stress responses, cardiovascular regulation, stress, obesity, anorexia, cachexia, stress, growth, puberty, infertility, stress, thyroid regulation, diabetes, ’roid rage, depression, stress
355. how he mammillary nuclei fit into the rest of the hypothalamus in terms of their function

LIMBIC SYSTEM, Edward J. Neafsey, PhD
356. list several examples of self-preservation or species-preservation activities and behaviors regulated by the limbic system
357. the number of different types of olfactory receptor molecules that are expressed in humans and how many are expressed by an individual olfactory receptor cell
358. the cortical target of olfactory sensory inputs and where it is located in the brain
359. how amygala lesions affect recognition of facial expressions (fear, anger, surprise, happiness, sadness, or disgust)
360. the limbic system structures that directly affect autonomic outflow
361. the part of the hippocampal formation giving rise to the fornix and where the fornix terminates
362. the “trisynaptic pathway” circuitry of the hippocampus and long term potentiation (LTP)
363. what hormone is regulated by the hippocampus
364. what aspect of memory is impaired by bilateral hippocampal lesions
365. HM’s symptoms after bilateral medial temporal lobectomy
366. the definition of the Papez circuit
367. the symptoms of the Kluver-Bucy syndrome

CLINICAL CORRELATION: HEADACHE
368. the basic mechanisms producing headache in general
369. the typical signs and symptoms for migraine, with and without aura, and for cluster headache
370. current hypotheses for the pathophysiology of migraine and the rationale for its treatment (abortive and prophylactic medication)
371. the typical signs and symptoms for tension (muscle contraction) headache, associated disorders and treatment
372. the signs and symptoms, diagnostic and treatment approaches to other headache syndromes, including pseudotumor cerebri, temporal arteritis and trigeminal neuralgia
373. the ominous signs or symptoms that mandate an emergent or urgent evaluation of headache

EPILEPSY
374. how epilepsies are classified, the two main types of “partial” seizures, and the two main types of “generalized” seizures
375. the neuronal events occurring during interictal spike in the EEG
376. what neurons in an epileptic focus doing during an interictal spike
377. what mechanisms normally prevent neurons from firing too much
378. what part of brain is malfunctioning in complex partial seizures
379. what brain tissue is removed in a temporal lobectomy for epilepsy

CEREBRAL CORTEX AND HEMISPHERIC SPECIALIZATION
380. the two primary types of aphasia and the lesions that cause them each
381. the “catastrophic reaction” after a stroke
382. the stroke lesion that produces profound contralateral neglect
383. provide examples of drawings made by patients with contralateral neglect
384. Why the split-brain patient said he chose the shovel, what hemisphere was speaking, and what was the real reason why the split brain subject chose the shovel

VISUAL SYSTEM I, II, & III
385. the embryonic development of the eye (see chapter 2 for additional reference)
386. the anatomy of the eye, including its concentric tissue layers and the function of its various chambers
387. the location of aqueous humor and how it is produced within the eye; the anatomical structures involved in removal of aqueous humor and what happens when there is pathology associated with these structures
388. the structures of the eye responsible for determining optical power and how do these structures change for distant or near vision
389. the major optical deficits, their anatomical distinctions, and how are these defects corrected
390. the clinical significance of the fundal exam
391. where on the fundus the macula/fovea be found and what is the unique cellular composition of the fovea, and why macular degeneration is so devastating
392. the various layers of the mammalian retina and the cells associated with these layers and how the various cells contribute to phototransduction
393. what are M:\:\:ller cells
394. the function of the pigment epithelium
395. the structural and functional differences between rod and cone photoreceptors and how do they differ in morphology, light sensitivity, adaptation, wavelength of light absorbed, number of bipolar cell synaptic contacts made
396. how light is absorbed by the photoreceptor and what chemical changes occur following light absorption
397. how photons cause photoreceptor membranes to hyperpolarize
398. what ion channels are affected by photons and how are they affected
399. what is meant by amplification and how does it apply to phototransduction
400. If photoreceptors hyperpolarize in response to light, explain how we can see in the daylight
401. the definition of visual receptive fields
402. the significance of center-surround receptive fields
403. be able to correctly project objects in our visual fields onto the retina
404. how objects within our visual fields are represented in the visual pathway
405. do optic tract neurons terminate and how are they distributed
406. the subdivisions of the lateral geniculate nucleus and the significance of these subdivisions
407. the basic types of ganglion cells
408. how retinotopic topography is maintained
409. how objects in our inferior visual fields project to what part of our visual cortex and what structures do they circumvent on their way to the visual cortex
410. the visual field deficits result from lesions affecting selected parts of the visual pathway Bitemporal heteronymous hemianopsia is suggestive of what structural defect might cause this structural defect
411. the significance of macular sparing within a visual field deficit
412. the visual receptive fields of the LGN and how do they relate to cortical processing of visual information

CLINICAL CORRELATION: BASAL GANGLIA
413. the anatomical correlates of akinetic or bradykinetic vs. hyperkinetic movement disorders with the basal ganglia and its circuitry
414. the primary or cardinal manifestations of Parkinson's disease, as well as secondary signs and symptoms
415. the most common cause of the parkinsonian clinical syndrome
416. the basic pathophysiology of Parkinson's disease, and the rationale for its medical and surgical treatment
417. the common side-effects of dopaminergic therapy
418. the typical clinical features of Huntington's disease, means of diagnosis and available treatments

SLEEP DISORDERS
419. the different phases of sleep
420. how REM and NREM sleep differ
421. how sleep patterns change with age
422. the ascending arousal system and its role in sleep
423. the sleep activating center and its main connections
424. the role of the suprachiasmatic nucleus in sleep
425. the major types of sleep disorders, their characteristics and consequences
426. the role of orexin/hypocretin or histamine in sleep

AUDITORY SYSTEM I & II
427. the function of the middle ear
428. the acoustic stapedius reflex
429. where the endolymph and perilymph are located, produced and removed from the inner ear; the differences in chemical composition of both fluids and their functions
430. how sound transduction occurs; the trap door theory of hair cell excitation
431. how the electrical change in membrane potential in hair cells induces excitation of cochlear nerve fibers
432. an example of conductive hearing loss
433. an example of sensorineural hearing loss
434. an example of central hearing loss
435. an example of genetic hearing loss
436. the routes of conduction to inner ear
437. the role of middle ear
438. how sound frequency separation occurs
439. how sound transduction occurs
440. the CNS auditory pathway from cochlea to cortex
441. the different basic types of hearing loss

CLINICAL CORRELATION: VISUAL, AUDITORY & VESTIBULAR SYSTEM
442. how visual acuity and visual fields are tested clinically
443. the anatomy of the visual system pathways
444. how various visual field defects relate to specific lesions in the visual system, including scotomas, heteronymous and homonymous deficits
445. the appearance of the normal, swollen and “atrophic” optic disc and the significance of each
the signs and symptoms of syndromes of visual loss, including optic neuritis, pituitary tumor and cortical blindness
how auditory acuity is tested clinically
the types of deafness (sensorineural, conductive) and how do you distinguish them
bedside testing of the vestibular system (Nylen-Barany or Dix-Hallpike maneuver)
the signs and symptoms of positional vertigo and Menieres disease

PAIN I & II
how pain is classified by pathophysiology, by etiology, and by affected area
nociceptive pain and how is it caused
neuropathic pain and how is it caused
acute pain
chronic pain
the primary afferent nociceptors
two main classes of peripheral nerve pain afferents and the type of pain does each produce
where is Rexed’s laminae do primary pain afferents terminate in the spinal cord
what pathway carries pain information to higher levels of the brain and where does this pathway terminate
where in the thalamus the pain pathway terminate in the cortex and where this thalamic nucleus projects
the modulation of pain transmission and what brain structure is most linked with pain modulation
the role of local anesthetics in managing pain
the role of sympathetic nervous system in pain

CLINICAL CORRELATION: BEHAVIOR & CORTICAL FUNCTION
amnesia, apraxia, agnosia and the lesions or diseases associated with each
aphasia and what disease is associated with it
the signs and symptoms associated with syndromes of the frontal, temporal, parietal and occipital lobes
the “frontal lobe release signs,” including how to recognize them, elicit them and their significance
the concepts of anosognosia and hemispatial neglect
the signs and symptoms of delirium (acute confusional state) and its likely causes, directly or indirectly related to the nervous system
“dementia,” the signs and symptoms associated with it, and its reversible or treatable versus untreatable causes
the diagnostic evaluation for a patient with dementia
the pathological correlates, clinical features and current treatment of Alzheimers dementia, including end-of-life issues and decisions

CLINICAL CORRELATION: INTOXICATIONS&INFECTIONS of THE NERVOUS SYSTEM,
473. the signs and symptoms, diagnostic testing and medical management of intoxications of the nervous system involving bacterial toxins (tetanus, botulism), illicit drugs and environmental or occupational toxins
474. the adverse effects of alcohol on the nervous system, including alcohol withdrawal seizures, alcohol withdrawal syndrome and Wernicke-Korsakoff syndrome with available treatments of each
475. the basic pathogenesis of infectious meningitis, its typical clinical presentation, diagnostic testing (emphasizing cerebrospinal fluid analysis), complications and therapy
476. how you distinguish bacterial from viral meningitis and the causes of each
477. the typical presentation of chronic meningitis and its causes
478. the signs and symptoms associated with encephalitis, the different types involved, and diagnostic and therapeutic measures
479. the typical clinical presentation and anatomical correlates of the viral diseases polio and shingles (zoster)
480. the typical clinical presentations and diagnostic findings of Creutzfeldt-Jakob dementia, an example of prion disease
481. the typical presentations and management of nervous system abscesses
482. the different neurological disorders associated with acquired immunodeficiency syndrome (AIDS), their clinical presentation and management, including progressive multifocal leukoencephalopathy (PML), opportunistic infections and vacuolar myelopathy

CLINICAL NEUROLOGY: DEGENERATIVE DISEASES, Michael Merchut, MD
483. what is meant by the concept of “selective vulnerability” with regard to neurodegenerative diseases
484. the age of onset, modes of inheritance if any, and clinical features of the major neurodegenerative diseases
485. the gross as well as major microscopic findings of the major neurodegenerative diseases

CLINICAL NEUROLOGY: CEREBROVASCULAR DISEASE
486. the differences between global vs. focal cerebral ischemia
487. the differences between ischemic and hemorrhagic infarctions
488. the differences between hemorrhagic infarctions and true cerebral hemorrhages
489. the differences between large and small vessel cerebral vascular disease

CLINICAL CORRELATION: CEREBROVASCULAR DISEASE, John Lee, MD
490. why appropriate stroke therapy involves accurate localization and characterization of the vascular lesion in the central nervous system
491. the theoretical mechanisms for thrombosis and embolism in cerebral and cervical arteries
492. how to clinically distinguish involvement of the large arteries versus lenticulostriate arteries in cases of ischemic infarction
493. collateral blood flow in the setting of carotid or vertebrobasilar artery disease
494. a “transient ischemic attack,” and its typical syndromes and appropriate diagnostic and therapeutic Measures
495. the management of an acute ischemic infarction, the use of appropriate diagnostic testing (including CT and MRI scans) and indications for specific medical or surgical therapy
496. the different types and causes of cerebral hemorrhage, presenting clinical syndromes, and indications for medical or surgical therapy
497. the causes of subarachnoid hemorrhage, clinical presentation, diagnostic methods and indications for medical or surgical therapy

CLINICAL CORRELATION: NEUROPATHY, MYOPATHY & MOTOR NEURON DISORDERS
498. the clinical findings in mononeuropathy and polyneuropathy
499. the significance of axonal vs. demyelinating causes of neuropathy
500. the indications for electromyography and nerve conduction testing, as well as nerve biopsy, in cases of neuropathy
501. how to test for the common causes, especially treatable ones, of neuropathy
502. the typical signs and symptoms of hereditary neuropathy
503. the typical signs and symptoms of Guillain-Barre syndrome, and its diagnostic and therapeutic management
504. the signs and symptoms of myopathy, and its diagnostic evaluation
505. the clinical presentations, course and treatment of polymyositis and muscular dystrophy
506. the signs and symptoms of motor neuron disease, especially amyotrophic lateral sclerosis (ALS)
507. the means of diagnosing ALS, therapeutic measures and end-of-life issues and decisions

CLINICAL NEUROLOGY: PATHOLOGY OF BRAIN TUMORS
508. how common brain tumors are in adults in children
509. where brain tumors most commonly are located in adults and in children
510. how the terms “benign” and “malignant” apply to brain tumors
511. the clinical signs of a brain tumor in adults and in children
512. the meaning and pathology of different types of brain tumors, including glioma, astrocytomas of different grades, oligodendroglioma, ependymoma, medulloblastoma, meningioma, schwannoma, pituitary adenoma, metastatic brain tumors
513. the various causes of brain tumors
514. the various treatments for brain tumors

CEREBRAL SPINAL FLUID, CEREBRAL VASCULATURE, AND THE BLOOD BRAIN BARRIER
515. the anatomy of the ventricular system
516. the circulation of the CSF
517. the choroid plexus
518. the function of arachnoid villi
519. the basis of the blood brain barrier
520. causes of elevated intracranial pressure
521. herniations different kinds
522. hydrocephalus (communicating non-communicating)
523. main cerebral vessels and what cortex each supplies
524. the main dural venous sinuses

NEUROPSYCHOLOGY
525. what unique diagnostic information does the neuropsychological exam provide (beyond other methods such as neuroimaging, lab tests, and the neurological exam)
526. how is a “normal” score on a neuropsychological test determined
527. Relative to dementia, how does the neuropsychological exam help determine whether an elderly patient has declined, is just old, or was always like this
528. Domains in the neuropsychological exam include attention, perception, language, memory, and executive functions. Which is typically more impaired in Alzheimer’s disease? Which is more impaired in progressive supranuclear palsy?

DEVELOPMENT II
529. neural induction and recall the origin of cells in both the PNS and CNS
530. how does cellular determination occur in the CNS
531. cell migration and axonal pathfinding
532. target selection, programmed cell death, and synaptic elimination
533. “critical” period as it relates to NS development
534. compare genetic determinants vs early experience in terms of impact on NS development
535. the roles of trophic factors in NS development and function
536. explain the phrases “ontogeny recapitulates phylogeny” and “regeneration recapitulates development”

INJURY & REGENERATION
537. how concepts learned from the neurodevelopment lectures apply to adult NS injury
538. the differences between regeneration and plasticity, and why both processes are important in therapeutic strategies for neurological damage
539. “anterograde” and “retrograde” reactions in PNS damage
540. “intrinsic vs extrinsic” factors in NS injury and repair
541. the role of trophic factors in NS regeneration and their cellular sources
542. the glial cell (Schwann cells, microglia, astrocytes, oligodendrocytes) reactions to injury
543. the olfactory ensheathing cell and why it has such potential in the treatment of spinal cord injury
544. the relationship between a “critical period,” neural plasticity, and NS modification by experience
545. the factors influence regeneration
546. neural plasticity, relative to the concept of “transneuronal degeneration/regeneration”
547. the meaning of “synaptic reclamation and collateral sprouting”

PLASTICITY & NEURAL REPAIR
548. why neonates often show better recovery from brain damage than adults
what inhibitory molecules are present in myelin and inhibit new axonal growth
what cortical reorganization occurs after stroke lesions and how it can be
enhanced to improve functional recovery in adults

**Interpersonal and Communication Skills**

By the end of this course, students must have demonstrated knowledge of the basic principles of effective interpersonal communication, and the skills and attitudes that allow effective interaction with their peers, faculty, and support staff. Students will:

1. Use verbal language effectively.
2. Use effective listening skills and elicit and provide information using effective nonverbal, explanatory, and questioning skills.
3. Facilitate the learning of other students, including giving effective feedback.
4. Communicate essential information effectively within their small group and with other students in the class.

**Lifelong Learning, Problem-solving and Personal Growth**

By the end of this course students must demonstrate the knowledge, skills and attitudes needed to be able to use appropriate tools of evidence to identify and analyze books, reviews, online resources, and basic science reports for their applicability towards quality in healthcare and quality improvement. Students will:

1. Apply acquired knowledge effectively.
2. Locate, appraise, critically review and assimilate evidence from scientific studies and medical literature.
3. Demonstrate an investigatory and analytic thinking approach in SGPSS and course projects.
4. Demonstrate a commitment to individual, professional and personal growth.

**Professionalism, Moral Reasoning and Personal Growth**

By the end of this course, students must demonstrate a combination of knowledge, skills, attitudes, and behaviors necessary to function as a respected member of a learning team in both small group and large class settings. Students will:

1. Behave professionally in the context of the small group problem-solving session, including attendance, punctuality, preparedness, and ability to interact effectively with other small group members in the educational setting.
2. Recognize and effectively deal with unethical behavior of other members of the class, if encountered.