

Phase II
Section: Brain and Behavior

Goals

Upon completion of Phase II Brain and Behavior section the student is expected to be able to discriminate normal function from the common neurological or psychiatric disorders.

1. Clinical Medicine

- a. Effectively interview patients, establish rapport, and evaluate patients in order to gather essential symptoms and accurate information pertinent to common neuropsychiatric disorders
- b. Effectively examine patients in order to attain pertinent signs necessary for the diagnosis of patients with neuropsychiatric disorders
- c. Discriminate between normal from abnormal findings seen in the physical examination of common neuropsychiatric disorders
- d. Accurately organize and document information gathered in a patient encounter into SOAP (Subjective, Objective, Assessment, Plan)/progress notes and complete histories and physical exams (H&P) on patients with neuropsychiatric disorders
- e. Develop strategies to explain the clinical presentation and pathophysiology of various common neuropsychiatric disorders
- f. Develop basic differential diagnoses for common neurological and/or psychiatric disorders
- g. Develop an understanding of the various methods to evaluate neuropsychological disorders
- h. Develop treatment algorithms for common neuropsychiatric disorders
- i. Major content areas
 - i. Psychiatry (see Appendix A)
 - ii. Neurology (see Appendix B)
 - iii. Toolboxes (see Appendix C)

2. Medical Arts

- a. The medical arts curriculum within Brain and Behavior is designed to help students understand the contextual practice of medicine and patient experience, including such topics as:
 - i. Medicine and Society: Describe the major sociocultural issues surrounding the practice and acceptance of neuroscience within modern medicine, society, and popular culture.
 - ii. Professionalism: Describe the principles of professionalism in neuropsychological disorders. Demonstrate the ability to act professionally toward patients and colleagues in educational and clinical settings.
 - iii. Ethics: Demonstrate understanding of the major ethical principles related to the practice of psychiatry and the treatment of mental illness, and neurology and the treatment of organic brain disease.
 - iv. Communication Skills: Describe the importance of interpersonal communication in the neurosciences. Communicate effectively with patients, families and medical colleagues across a broad range of socioeconomic and ethnic backgrounds to assure comprehensive patient care.
 - v. Doctor-Patient Relationship: Describe the important aspects of the doctor patient relationship in the practice of medicine. Demonstrate an understanding of patient confidentiality and protected health information.
 - vi. Physician Development: Describe the various aspects of personal development in the practice of medicine, including self-reflection, independent learning, and an appreciation of the unique aspects of caring for the mentally ill.
 - vii. Medical Economics: Describe the impact of modern medical financing on patients and the practice of medicine. Recognize the business aspects of practice management and the complex nature of practicing cost-effective health care and resource allocation without compromising quality of care.

- viii. **Medical Systems:** Describe how the impact of various and competing medical care systems impact patients and the provision of neuropsychiatric medical care. Demonstrate ability to use information technology, multidisciplinary resources and operate within systems of health care to improve care of the patients
- ix. **Medical Humanities:** Describe the role of the humanities in developing a larger socio-cultural understanding of the development and current practice of neuroscience.

3. Medical Science

a. Neuroanatomy

i. Gross anatomy of the brain

1. Identify major structures in coronal, axial, and sagittal sections of the brain
2. Identify the structures of, and components within, the six postembryonic divisions of the brain:
 - i. telencephalon
 1. Cerebral hemispheres: frontal, parietal, temporal, and occipital lobes with associated gyri and lobules
 - a. insular lobe
 - b. limbic lobe
 2. basal ganglia and its components
 - a. caudate nucleus
 - b. putamen
 - c. globus pallidus
 - d. amygdaloid nuclear complex
 3. lateral ventricles
 4. cerebral cortex
 5. white matter:
 - a. commissures of the cerebral cortex:
 - i. corpus callosum
 - ii. anterior commissure
 - iii. hippocampal commissure (commissure of the fornix)
 - b. internal capsule
 - ii. diencephalons: epithalamus, thalamus, hypothalamus, subthalamus, and the 3rd ventricle
 - iii. mesencephalon (midbrain): cerebral peduncle, interpeduncular fossa with CNIII, superior colliculus, inferior colliculus, and trochlear nerve
 - iv. pons, including the cranial nerves V, VI, VII, and VIII, as well as the locus ceruleus, facial colliculus, sulcus limitans, and striae medullares
 - v. medulla oblongata: pyramid, olive, cranial nerves IX, X, XI, XII, gracile and cuneate tubercle, rhomboid fossa, hypoglossal trigone, sulcus limitans, and area postrema
 - vi. cerebellum: hemispheres, vermis, flocculus and vermal nodulus, tonsil, superior/middle/inferior cerebellar peduncles, and lobes (anterior, posterior, flocculonodular)

ii. Meninges and cerebrospinal fluid

1. Describe where CSF is produced and how it circulates and is removed
2. Name the most likely sites of obstruction of CSF circulation and the consequences
3. Explain what the meninges cover and what spaces they surround

4. Name the regions of the brain associated with each part of the ventricular system
 5. Identify the lateral ventricles within different regions of the hemispheres
- iii. Blood supply of the central nervous system
1. Identify the blood supply of the spinal cord
 - a. Arterial: anterior and posterior spinal arteries, including the artery of Adamkiewicz
 - b. Venous
 2. Identify the blood supply of the brain and its branches:
 - a. Anterior circulation: internal carotid artery, ophthalmic artery, central artery of the retina, posterior communicating artery, anterior choroidal artery, anterior cerebral artery, anterior communicating artery, and middle cerebral artery
 - b. Posterior circulation: vertebral artery, anterior and posterior spinal arteries, posterior inferior cerebellar artery, basilar artery with anterior inferior cerebellar artery, superior cerebellar artery, posterior cerebral artery
 3. Describe the anastomosis between the anterior and posterior circulations of the brain: the arterial circle of Willis
 4. Describe and identify the meningeal arteries: anterior, middle, posterior meningeal arteries
 5. Describe and identify the draining veins of the brain: superficial cerebral and deep cerebral veins
 6. Describe and identify the venous dural sinuses of the brain: superior sagittal, straight, transverse, confluence of sinuses, sigmoid, and cavernous sinuses
 7. Identify the common sites of berry (saccular) and microaneurysms (Charcot-Bouchard aneurysms)
- iv. Development of the nervous system
1. Describe the development of the CNS from the neural plate to the 5 subdivisions of the neural tube.
 2. Describe what happens to the neural canal and the adult names given to its derivatives.
- v. Spinal cord, motor neurons, and reflexes
1. Explain why the spinal cord is not always opposite the corresponding vertebra
 2. Describe where would you remove CSF when performing a spinal tap
 3. Name the general regions of the gray and white matter of the spinal cord
 4. Describe how would you recognize a particular section of the spinal cord as cervical, thoracic, lumbar, or sacral
 5. Locate the region in the spinal cord where you would find neurons associated with the autonomic nervous system
 6. Describe the 4 components of a spinal nerve
 7. Describe the terms dermatome and myotome and their relationship to a spinal nerve
 8. Describe a reflex using the terms afferent and efferent. Further elaborate and diagram a monosynaptic, flexor, and crossed extensor reflex. Locate the cells (bodies) for the reflexes.
- vi. Tracts
1. Anterolateral system (spinothalamic system of pain and temperature)
 - a. Describe the sensory modalities mediated by the ALS
 - b. Locate the first, second, third order neurons, and know where the crossing occurs for the anterolateral system
 - c. Trace the ALS pathway from the periphery to the cortex

- d. Identify cranial nerve motor nuclei that are near the ALS pathway and that might be supplied by the same artery
 - e. Define a dermatome and explain why they are useful
 - f. Know the dermatomes represented at the level of the back of the head, shoulder, thumb, middle finger, small finger, nipple, umbilicus, inguinal ligament, big toe, small toe and anus
 - g. Explain the sensory loss with a pathological enlargement of the central canal at the level of C 5,6,7
 - h. Explain why an extradural tumor pressing on the left side of the spinal cord at spinal level T8 only produced loss of pain and temperature and not other sensations from the leg
 - i. Define the term somatotopic and explain how this applies to the cerebral cortex.
2. Dorsal column-medial lemniscus system (DCML)
- a. Compare and contrast the differences and similarities between the ALS and DCML pathways. Do this from memory using the drawing from the Haines atlas
 - b. Explain the term sensory dissociation and explain why the concept is useful
 - c. Name the arteries that supply the DC-ML pathway in the cord, medulla, pons, and cerebral cortex
 - d. When performing a sensory examination, explain which of the two sensory pathways the sensory modalities traveling in
3. Corticospinal tracts and the internal capsule
- a. Diagram the corticospinal tract
 - b. Recognize the names the corticospinal tract has in different regions of the brainstem, even though the axons are the same
 - c. Name the different blood vessels that supply the corticospinal fibers at different levels of the CNS
 - d. Locate nuclei with lower motor neurons in the brain stem, and explain how they are controlled
 - e. Explain why a lesion in the internal capsule can be more devastating than a lesion of the same size in the cerebral cortex
 - f. Compare and contrast the function and dysfunction of upper and lower motor neurons
 - g. Compare the differences seen on exam when a patient has a lesion of the corticospinal tract vs a damaged ventral root
 - h. Explain why a paraplegic can still have a patellar reflex
- vii. Brainstem and cranial nerves
- 1. Name the cranial nerves and know their components and functions
 - 2. Identify and locate the cranial nerves associated with the medulla, the pons and the midbrain
 - 3. Explain how cranial nerves differ from spinal nerves
 - 4. List the cranial nerves that contain parasympathetic fibers and their function
 - 5. Recognize the major internal and external landmarks on the dorsal and ventral surface of the brain stem, so that you can determine if a gross or stained cross section is medulla, pons or midbrain
 - 6. Identify on cross sections all the brain stem nuclei containing motor neurons, except for the salivatory nuclei
 - 7. Explain why cranial nerves are so important in localizing lesions
 - 8. Name reflexes that test these nerves
- viii. Trigeminal system
- 1. Outline the two pathways for facial sensation from the head

2. Contrast facial sensation from the head and somatic sensation from the body, and draw this on the Haines atlas diagram
 3. Diagram the corneal reflex: the afferent and efferent limbs and the nuclei involved in the brainstem
 4. Determine how one would decipher if a patient who is unable to blink has a problem in the sensory (afferent) limb, the motor (efferent) limb, or the brainstem interconnections for the corneal reflex
 5. Explain how a single, small medullary vascular lesion could abolish pain and temperature from the right face, and pain and temperature from the left body, and explain what vessel supplies this area
- ix. Vestibular system
1. Describe structure of vestibular receptors (cristae, maculae, cupula, otolithic membrane, hair cells)
 2. Describe the location and function of the lateral and medial vestibulospinal tracts originating in the vestibular nuclei
 3. Diagram the vestibulo-ocular reflex, and explain when and how this reflex can be tested
 4. Explain the mechanism by which the vestibular system influences extensor muscle tone
 5. Describe what is seen with a lesion of unilateral/bilateral medial longitudinal fasciculi (MLF), and explain how it can be distinguished from a lesion of CN III or CNVI
- x. Auditory system
1. Explain the basic organization of the middle ear and cochlea, including the names and location of the receptors
 2. Describe the structures that could be affected and the clinical findings associated with a schwannoma (benign schwann cell tumor) on the VII or VIII nerve in the cerebellopontine angle, and explain how it would be different if it were in the internal auditory meatus
 3. Explain why lesions of the auditory pathway are harder to localize and of less clinical value than those of the DCML system
 4. Describe where in the nervous system a lesion would have to be for a person to have deafness in the ipsilateral ear
- xi. Cerebellum
1. Compare the clinical features of disease of the cerebellum, basal ganglia and cerebral cortex
 2. Identify the cerebellar vermis, hemispheres, lobes, peduncles and dentate nucleus
 3. Describe cerebellar internal circuitry, afferents and efferents
 4. Name six CNS sites where disease causes cerebellar signs
 5. Describe and recognize the signs of the three cerebellar efferent divisions
- xii. Thalamus
1. Be able to recognize the general areas of the forebrain and associate them with basic function
 2. Understand the subdivisions of the thalamus
 3. Recognize the internal capsule as a landmark and "highway"
 4. Understand the basic histological plan of the cerebral cortex and the pattern of input and output
- xiii. Visual system
1. Describe the embryology of the retina and its relationship to the CNS
 2. Describe the production, circulation and removal of aqueous humor
 3. Describe the differences in the vascular supply to the inner and outer portions of the retina
 4. Name the neural elements that compose the retina, their location and function within the retina

5. Explain for what purpose the macula/fovea exists
 6. Explain the terms choked/raised disc, and depressed/cupped disc, and explain the pathophysiology that leads to these states
 7. Explain how an image is brought into focus on the back of the retina
 8. Describe the pathway of visual information from the retina to the visual cortex
 9. Draw the expected visual fields seen in classic lesions of the nerve, chiasm, thalamus, radiations, and cortex
 10. Describe the blood vessels that, when occluded, could lead to visual problems, as well as the expected field loss
 11. Explain why the finding of macular sparing is useful diagnostically, despite the fact that there are various explanations for its existence
 12. Describe accommodation and the near reflex and their structural basis
 13. Explain how a bright light shined in one eye causes both pupils to constrict
 14. Name three CNS and three PNS structures that when damaged unilaterally, interrupt the pupillodilator pathway
 15. Explain why ptosis can result from lesions in two very different pathways
 16. Explain the importance given to dilated pupils in a trauma patient or person with loss of consciousness, as well as the other signs or symptoms seen
 17. Identify areas of the cortex which when stimulated or lesioned could result in difficulty with voluntary saccadic eye movements or conjugate deviation of the eyes
 18. Identify where a brainstem lesion would affect conjugate horizontal gaze
 19. Describe how one would test for a horizontal gaze paralysis, and how one would distinguish this from a lesion of the MLF
 20. Explain how a person could have apparent paralysis of the left medial rectus on right horizontal gaze but could still focus on near objects
 21. Localize lesions based upon a diagram of eye positions and pupil diameters in response to various commands
- xiv. Autonomic nervous system
1. For pre- and postganglionic neurons, name their transmitters and the receptors they act on
 2. Describe which cranial nerves contain parasympathetic neurons, their function, and the location of the postganglionic cells
 3. Explain how all peripheral vessels have sympathetic innervation, but only T1-L2 spinal cord segments give rise to preganglionic sympathetic neurons
 4. Draw the baroreceptor reflex and explain the reflex responses to hypertension and hypotension
 5. Contrast a visceral reflex with a somatic reflex
- xv. Hypothalamus
1. Identify the hypothalamus and its boundaries, tuber cinereum, mammillary bodies, and pituitary stalk
 2. Describe the neural and circulatory system afferents to the hypothalamus
 3. Compare neuroendocrine secretion and control in the anterior and posterior pituitary
 4. Describe the signs caused by disease of the hypothalamus
- xvi. Olfactory, gustatory, and limbic systems
1. Identify the olfactory bulb and tract, cingulate and parahippocampal gyri, hippocampal formation, fornix, mammillary body, anterior nucleus of the thalamus, amygdala and uncus

2. Describe the Papez circuit
3. Describe olfactory and limbic system signs
- xvii. Basal ganglia and striatal motor system
 1. Compare the clinical features of disease of the basal ganglia, cerebral cortex
 2. Compare the terms *basal ganglia*, *extrapyramidal* and *movement disorder*
 3. Create a table of organization of basal ganglia components
 4. Identify caudate nucleus, putamen, nucleus accumbens, globus pallidus
 5. Draw and label a diagram of the Current Model of Basal Ganglia Motor Pathways
 6. Name three major parallel circuits of the basal ganglia
 7. Describe the pathophysiology and basic clinical features of Parkinsons, Huntington's disease, and hemiballism according to the Current Model
- xviii. Neurotransmitters and pathways
 1. Describe the neurochemical pathways involved in brain signaling:
 - a. Monoaminergic (catecholaminergic, indolaminergic)
 - b. Cholinergic: acetylcholine
 - c. Peptidergic: peptides
 - d. GABA-ergic: GABA
 - e. Glutamatergic: glutamate
 2. List the neurotransmitters which are catecholamines: dopamine, norepinephrine, epinephrine
 3. List the neurotransmitters which are indolaminergic: serotonin
 4. Identify the characteristics, pathways, and location of highest concentration of the major neurotransmitters:
 - a. Acetylcholine
 - b. Dopamine
 - c. Norepinephrine
 - d. Serotonin
 - e. Opioid peptides (endorphins, enkephalins, dynorphins)
 - f. Non-opioid neuropeptides (substance P, somatostatin)
 5. Identify the aminoacids involved in neurotransmission:
 - a. Inhibitory: GABA, glycine
 - b. Excitatory: glutamate, aspartate
- xix. Cerebral cortex
- b. Neurohistology
 - i. Identify the classification of neurons according to:
 1. processes (unipolar or pseudounipolar, bipolar, multipolar)
 2. axonal length
 3. function (sensory, motor, interneurons)
 - ii. Identify the nerve cell body and its structures (nissl substance, lysosomes, filamentous protein structures of microtubules and neurofilaments, inclusion bodies, dendrites, axons, nerve fibers, myelin sheath, synapses)
 - iii. Explain the classification of non-neural cells of the CNS and PNS, including astrocytes, oligodendrocytes, microglia, ependymal cells, schwann cells
 - iv. Discuss the tumors of neuroglial cells
 - v. Explain the concepts involved in nerve cell degeneration and regeneration affecting the CNS and PNS
 - vi. Discuss the mechanisms by which axonal transport occurs, including anterograde and retrograde transport
 - vii. (insert lysosomal storage diseases/glycolipids/glycoproteins)
 - viii. Describe the origins of the major cell types in the CNS, including, astrocytes, oligodendrocytes, ependymal, microglia, Schwann cells and neurons
 - ix. Explain the differentiation of neurons and glia from neural stem cells
 - x. Describe the important cell types of neurons

- xi. Describe the important of neuroglial cells
 - xii. Identify the diversity of cell types found in the nervous system
 - xiii. Differentiate between necrosis and apoptosis
 - xiv. Describe the interrelationships between ischemia, necrolysis and central chromatolysis
 - xv. Describe the implications of discovering inclusion bodies in the development of Alzheimer's and Parkinson's disease
 - xvi. Describe the process of Wallerian degeneration
 - xvii. Contrast axonal regeneration in the CNS and PNS
 - xviii. Recall the basic histology of neurons, astrocytes, oligodendrocytes, microglia, ependyma, etc
 - xix. Identify histological changes associated with ischemia and infarct, neoplasia, inflammation, abscess, amyloid, neurofibrillary tangles and Lewy bodies
 - xx. Describe the histological changes associated with vascular, inflammatory, neoplastic and metabolic/toxic diseases
 - xxi. Describe the histological changes associated with CNS or PNS trauma
 - xxii. Contrast the basic histology of axons with pathophysiological states
 - xxiii. Discuss the concept of axonal transport as axolemmal and axoplasmic disorders
- c. Neuropathology (get these from Steve Chin or Fred Clayton)
- d. Neuropharmacology (get these from Dani Roussel)
- e. Neurogenetics/neurogenomics (Renner to write these)
- i. Huntington's disease
 - ii. Mitochondrial cytopathies
 - iii. Trinucleotide repeat disorders
- f. Neuroimaging
- i. Describe the basic principles of CT, MRI and cerebral angiography
 - ii. Distinguish contrast-enhanced studies from nonenhanced studies
 - iii. Distinguish an MRI from a CT, and identify whether or not the image is contrast enhanced
 - iv. Distinguish MRI weighting (e.g., T1w, T2w, FLAIR)
 - v. Identify the imaging plane (axial, sagittal or coronal)
 - vi. Identify the side (left or right) of a lesion on images
 - vii. Correlate anatomy and neuroimaging with the clinical presentation of various diseases
 - viii. Name the most sensitive MRI imaging technique for most nonhemorrhagic lesions, acute infarction, and most hemorrhagic lesions
 - ix. Distinguish six angiography projections (4 arterial phase and 2 venous phase)
 - x. Identify the six major arteries of the brain as seen on cerebral angiography
 - xi. Identify on CT or MRI the structures presented from brain slices and the half brain, the quadrigeminal and suprasellar cisterns, and the cerebellopontine angle
 - xii. Systematically analyze an emergency CT
- g. Neurophysiology
- i. **Electrical signaling in the nervous system**
 1. Discuss the molecular and biophysical mechanisms involved in the formation of a resting membrane potential
 2. Describe how ionic movement produces electrical signals
 3. Discuss the significance of ionic equilibrium potential
 4. List the equilibrium potentials for sodium, potassium, calcium and chloride
 5. Identify the ion with the most variable equilibrium potential and discuss the mechanisms underlying the variations across cells.
 6. Compare and contrast the mechanisms involved in the graded vs. action potential formation

7. Explain how the common electrolyte disorders involving sodium, potassium, chloride and calcium will affect basic neural function
 8. Explain how the common electrolyte disorders involving sodium, potassium, chloride and calcium will affect synaptic communication
- ii. **Voltage-dependent membrane properties**
1. Describe the ionic currents found in neurons
 2. Discuss the important of voltage clamp and patch clamp methods in neurology
 3. Diagram an action potential and underlying ionic currents with correctly labeled axes, include the important ionic currents using the same time base and appropriate y axes
 4. Consider the role of the afterpotential in neuronal excitability
 5. List conditions that may result in excess discharge of action potentials
 6. Describe how anoxia and energy failure (eg, cyanide) affect action potential discharge
 7. Explain how cortical spreading depression affects neuronal excitability
 8. Describe the process of neuronal accommodation
 9. Discuss the propagation of action potentials in myelinated and non-myelinated axons
 10. Describe how threshold and passive membrane properties affect action potential initiation
 11. Compare neuronal function in the presence and absence of sodium, potassium, chloride and calcium channel blocker
 12. Define refractory period as pertains to neurons
 13. Explain the process of myelination
 14. Distinguish between myelin the CNS and PNS
 15. Illustrate how action potential propagation is altered by demyelinating disease
 16. Explain why myelination increases conduction velocity
 17. Describe the clinical presentation of a patient with a demyelinating disease such as multiple sclerosis
 18. List the most commonly used classes of local anesthetics
 19. Discuss the mechanisms of action of the most commonly used local anesthetics
 20. Discuss the advantages and disadvantages of each of the local anesthetics currently in clinical use
- iii. **Channels and Transporters**
1. Identify the ion channels underlying the action potential
 2. Discuss the diversity of ion channels in the context of therapeutic interventions
 3. Compare and contrast the function properties of voltage-gated and ligand-gated ion channels
 4. Describe the roles of stretch and heat-activated channels in sensory perception
 5. List commonly encountered toxins known to affect ion channel function
 6. Discuss diseases resulting from channelopathies
 7. Describe the role of ion transporters in the creation and maintenance of ion gradients.
 8. Describe the functional and structural properties of the sodium/potassium ATPas
 9. Describe the roles of the cytoskeleton and axonal transport in normal neural function
 10. Describe the process of neurosecretion
- iv. **Synaptic transmission**

1. Diagram an electrical synapse and name the important molecular structures
 2. Diagram a chemical synapse and identify the important molecular structures
 3. Explain the criteria that define a neurotransmitter
 4. List the important classes of neurotransmitters
 5. Explain the quantal release of neurotransmitters
 6. Discuss the process of synaptic vesicle release, including the role of calcium and the local recycling of synaptic vesicles
 7. Describe diseases that affect the presynaptic terminal
 8. Discuss the toxins that affect neurotransmitter release
 9. Compare and contrast the release of neuropeptides with the low molecular weight neurotransmitters
 10. List the major neurotransmitter receptors and discuss their distributions throughout the central and peripheral nervous systems
 11. Describe the changes in postsynaptic membrane permeability occurring during synaptic transmission
 12. Explain the ionic origins of excitatory and inhibitory postsynaptic potentials
 13. Describe the significance of the temporal and spatial summation of synaptic potentials
 14. Differentiate the two major types of postsynaptic receptors (ionotropic vs. metabotropic)
 15. Design an experiment to distinguish ionotropic from metabotropic receptor activation
 16. Describe basic neural circuits including, relay, diffuse and local circuits
- v. **Neurotransmitters and receptors**
1. List the categories of neurotransmitters
 2. Describe the receptors involved in the detection of neurotransmitters, including acetylcholine, glutamate, GABA, glycine, biogenic amines, ATP, purines, neuropeptides and the unconventional neurotransmitters.
 3. Discuss addiction in the context of acetylcholine and ACh receptors in nicotine
 4. List neurotoxins targeting postsynaptic receptors
 5. Discuss the clinical presentation of myasthenia gravis
 6. Explain the disease mechanisms resulting in myasthenia gravis
 7. Define excitotoxicity and explain the molecular mechanisms underlying the phenomena
 8. Discuss the role of biogenic amine neurotransmitters in psychiatric disorders
- vi. **Intracellular signaling**
1. Identify the neurotransmitter receptors that initiate intracellular signaling cascades upon activation
 2. Discuss the effectors activated by these signaling cascades and their role in neuronal function
 3. Describe the g-protein cycle of activation
 4. Discuss the functional significance of protein kinases and phosphatases in neuronal function
 5. Describe the role of nuclear signaling in neuronal function
- h. **Neuroanatomy**
- i. Identify the topography, anatomy, and functional levels of the:
 1. Spinal cord: describe the basic anatomy of the spinal cord, including, nerve roots, nerves, meninges and blood supply
 2. Brainstem
 3. Forebrain

- ii. Lower motor neurons
 - 1. Describe the distribution of the following peripheral nerves, median, ulnar, axillary, radial, sciatic, femoral tibial & peroneal
- iii. Pyramidal system
- iv. Brainstem motor centers
 - 1. posturing
 - 2. postcapsular lesion recovery
- v. Basal ganglia
- vi. Cerebellum
- vii. Oculomotor system
 - 1. vestibule-ocular reflex and conjugate gaze
- viii. Somatosensory system
- ix. Visual system: anopsia
- x. Auditory system: deafness
- xi. Gustatory and olfactory systems
- xii. Cerebral cortex
- xiii. Limbic system
- xiv. Hypothalamus
- xv. Autonomic nervous system
- xvi. Blood supply of the CNS
 - 1. Locate the following arteries; vertebral, posterior communicating, common/internal carotid arteries, anterior cerebral artery, middle cerebral artery, basilar artery and posterior cerebral artery
 - 2. Identify the cranial veins
 - 3. Describe the vascular territories and the neuroanatomical structures supplied by each
- xvii. Cerebrospinal fluid system
 - 1. Explain the anatomical organization of the ventricular system, including, dural, arachnoid, pia mater, epideral, subdural, subarchnoid, dural sinus, falx cerebri, tentorium cerebella, BBB, Choroid plexus, ventricles (lateral, 3rd & 4th), foramina (Monro, Luschka, Magendie), aqueduct of sylvius, CSF, hydrocephalus
- xxviii. Gross Anatomy: Identify the major anatomical structures in the head and neck
- xix. Locate the cranial nerves
- xx. Identify the following anatomical structures: corticospinal tract, cortical motor areas, cranial nerve nuclei, basal ganglia, flocculonodular, vermis, hemispheres, etc
- xxi. Name the cranial nerve nuclei with motor function
- xxii. Define final common pathway
- xxiii. Explain the clinical correlations associated with sensory, lower motor neuron, reflexes, autonomic, vertebral pain, dorsal columns, spinothalamic tract, descending motor pathways, radiculopathies, hemi-cord, Brown Sequard, transverse myelitis, monofocal cord lesions and multifocal cord lesions
- xxiv. Discuss how the organization of the spinal cord varies according to segment
- xxv. Describe the general anatomy of cranial structures located in the posterior fossa, including, cerebellum, medulla, pons, CSF and vascular supply Identify sensory white matter, including, dorsal root entry zone, proprioceptive spinal, dorsal columns, dorsospinocerebellar, spinothalamic and spinoreticular tracts
- xxvi. Identify motor white matter, including ventrolateral tract
- xxvii. Locate and explain the function of major medullary structures, including, decussation of pyramids, decussation of medial lemniscus, inferior olivary nucleus, MLF, inferior cerebral peduncle, cranial nerves 9, 10, 11, 12
- xxviii. Describe the basic anatomy and physiology of the thalamus including relay nuclei, association nuclei, reticular nuclei and vasculature
- xxix. Describe the functional anatomy of the basal ganglia

i. **Sensory systems**

i. **Somatic sensory system**

1. List the cutaneous and subcutaneous sensory receptors
2. Describe the mechanoreceptors detecting tactile sensation
3. Explain the concept of receptive fields and be prepared to demonstrate the principle
4. Discuss the mechanoreceptors specialized for proprioception
5. Diagram the afferent pathway involved in mechanoreception (dorsal column-medial lemniscus)
6. Discuss the role of the trigeminal nerve in mechanoreception
7. Compare receptive field and dermatome
8. Explain the somatosensory representation in the thalamus
9. Explain the organization of somatosensation in the sensory cortices

ii. **Pain**

1. Diagram a nociceptor free nerve ending and label the receptors/channels involved in nociceptive stimuli detection
2. Discuss the transduction of nociceptive stimuli
3. Diagram the central nociceptive pathways
4. Explain the embryological basis of referred pain
5. Explain the functional organization contributing to referred pain
6. Explain how the physiological processes of wind-up and central sensitization contribute to pain sensation
7. Describe mechanisms involved in the regulation of nociceptive transmission
8. Explain the concept of nociceptor sensitization
9. Describe the clinical presentation of phantom limbs and phantom pain
10. Discuss the anatomical pathways and functional mechanisms contributing to the descending control of pain perception
11. Discuss pain and placebo effect
12. Discuss the physiological basis of pain modulation
13. Describe the pharmacological approaches to treatment of acute pain
14. Describe the pharmacological approaches to treatment of chronic pain
15. Non-pharmacological approaches to pain and the placebo effect
16. Discuss the prescription of pain medications and the potential for their abuse
17. Describe the physiological basis and the rationale for the pharmacologic management of headache

iii. **Peripheral Vision**

1. Diagram the anatomy of the eye
2. Describe the gross anatomy of the eye
3. Identify the anatomical components of the eye that serve a role in image formation
4. Discuss the functional organization of the retina
5. Diagram the central visual pathways including diencephalic and telencephalic loci
6. Describe the clinical presentation for the top 10 central visual disorders
7. List the tools needed to conduct a complete visual test
8. Conduct a visual test
9. Describe the clinical presentations expected with disorders of the eye, retina, optic nerve, chiasm, tract, radiations or occipital lobe
10. Explain the anatomical structures that permit image formation on the eye
11. List disorders of the eye associated with refractive disorders
12. Diagram the retina
13. Explain phototransduction

14. Discuss the flow of information through retinal neurons
 15. Discuss the clinical presentation of retinitis pigmentosa
 16. Compare and contrast the functional properties of rods and cones
 17. Discuss the distribution of rods and cones and the functional consequences of this distribution
- iv. **Central visual pathways**
1. Identify the retinal neurons which project centrally and describe their projection patterns
 2. Explain the concepts of retinotopic representations and visual fields
 3. Discuss the clinical manifestation of visual field defects
 4. Discuss the functional organization of the visual cortex including the columnar organization
 5. Describe the flow of information in the primary visual pathway
 6. Explain the significance of the extrastriatal visual areas
- v. **Auditory system**
1. Explain the physics of sound, including the audible spectrum detected by humans
 2. Describe the anatomy of the external, middle and inner ear
 3. List the four main causes of hearing loss
 4. Provide an explanation that might help a patient understand the risks of loud music and headphones
 5. Explain the anatomical and physiological processes involved in the transduction of sound in action potentials in the auditory nerve
 6. Discuss how sound frequency and loudness are encoded
 7. Explain the difference between air and bone conduction of sound including the clinical implications
 8. Describe the central auditory pathways including the primary functions of the central nuclei
 9. Demonstrate a clinical test of basic auditory function
 10. Distinguish between central and peripheral auditory pathophysiology
 11. Explain how hair cells transduce sound into electrical activity
 12. Discuss the functions of the two kinds of hair cells found in the cochlea
 13. Explain how loudness and tone are encoded in the auditory nerve
 14. Describe central auditory pathways
 15. Explain the roles of the cochlear nucleus, lateral lemniscus, inferior colliculus, auditory thalamus and auditory cortex in the processing of sound
- vi. **Vestibular system**
1. Diagram and identify the anatomical features of the vestibular labyrinth
 2. Compare and contrast the activation of vestibular hair cells with auditory hair cells
 3. Identify the sensory systems involved in maintaining posture and balance
 4. Describe the anatomy and physiology of the peripheral vestibular system, including utricle, saccula, semicircular canals
 5. Discuss the formation and composition of endolymph in the auditory and vestibular systems
 6. Explain how the ionic composition of the endolymph affects hair cell sensory transduction
 7. Describe the central vestibular pathways including the primary functions of the central nuclei
 8. Describe the three most significant disorders of the vestibular system and explain the anatomical and/or physiological basis of the clinical manifestation

9. Describe the sensory stimuli that the otolith organs, the utricle and saccule, detect
 10. Explain how the otolith organs sense linear force
 11. Explain the functional organization of the semicircular canals
 12. Explain how the semicircular canals are able to detect angular acceleration
 13. Diagram and explain the central pathways for stabilizing gaze, head and posture
 14. Describe the vestibular pathways to the thalamus and cortex
- vii. **Chemical senses**
1. List the internal and external chemosensory systems
 2. Describe the organization of the peripheral and central olfactory system
 3. Discuss the physiological and behavioral responses to odorants
 4. Describe the functional processing of an odorant response from the initial transduction to its coding in the olfactory bulb
 5. Describe the organization of the taste system
 6. Discuss the functional processing of a taste response from its initial transduction to its central coding
 7. Compare and contrast the stimuli activating and chemosensory perceptions of the olfactory, taste and trigeminal systems
 8. Compare and contrast olfactory projections to the cortex with other sensory modalities
 9. Explain how olfactory deficits would present clinically and discuss the implications of such deficits in children, adults and the elderly
- j. **Movement and control of movement**
- i. **Lower motor neuron circuits and motor control**
 1. Diagram the anatomical organization of motor control systems
 2. Describe the relationship between motor neurons and skeletal muscle cells
 3. Describe the histology, physiology and pharmacology of the neuromuscular junction
 4. Discuss the origin of and clinically approved uses for Botulinum toxin
 5. Compare normal muscle histology with pathological states
 6. Identify clinical disorders of muscle including sarcolemma, dystrophinopathies, ion channelopathies and contractile mechanisms
 7. Explain the concept of a motor unit and identify the important types
 8. Explain the size principle as it relates to the motor neuron and recruitment of motor units
 9. Explain how the force of contraction is regulated
 10. Discuss stretch reflexes in the context of spinal cord circuitry
 11. Discuss the relationship between sensory activity and motor output
 12. Describe the influence of descending input on spinal reflexes
 13. Explain the neural circuits involved in a flexion reflex response
 14. Explain locomotion in the context of spinal cord circuitry
 15. Describe amyotrophic lateral sclerosis as a prototypical example of lower motor neuron syndrome
 16. List other lower motor neuron syndromes
 17. Discuss the clinical presentation of ALS
 18. Discuss the progression of ALS and the therapeutic strategies in current use
 19. Discuss the clinical findings associated with the muscle, neuromuscular junction and peripheral nerve disease
 20. Describe the laboratory tests used to identify disorders of the peripheral nervous system, including biochemical tests, immunological tests, electrophysiological tests and biopsy

21. Defend the selection of one of these tests in the diagnosis of peripheral nerve disease
 22. List the skeletal muscle relaxants in clinical use
 23. Describe the mechanisms of actions of muscle relaxants
- ii. **Upper motor neuron control of the brainstem and spinal cord**
1. Describe the circuits regulating descending control of spinal cord circuitry
 2. Identify the motor control centers in the brainstem
 3. Explain how upper motor neurons are involved in the maintenance of balance and posture
 4. Discuss the involvement of the reticular formation in motor control
 5. Name and diagram the upper motor neuron pathways that initiate complex voluntary movements (corticospinal and corticobulbar)
 6. Explain the importance of descending projections to cranial nerve motor nuclei in diagnosing motor deficits
 7. Compare and contrast the organization of primary motor cortex with primary somatosensory cortex
 8. Explain the concept of a “motor map”
 9. Explain the relationship between primary motor cortex and premotor cortex
 10. Describe the clinical presentation of a patient with upper motor neuron syndrome
 11. Discuss the relationship between muscle tone and upper and lower motor neuron syndromes
- iii. **Modulation of movement by the basal ganglia**
1. Describe the projections of the basal ganglia in the context of modulation of movement
 2. Describe the important circuits within the basal ganglia
 3. List the important neurotransmitters used in the basal ganglia
 4. Diagram a neural circuit diagram indicating the major connections to the basal ganglia, include the motor cortex, thalamus, cerebellum, brainstem and any final common pathways
 5. Identify the major disorders associated with basal ganglia dysfunction
 6. Describe the role of the basal ganglia in control of primary motor programs
 7. Contrast hypokinetic and hyperkinetic activity
 8. Compare the role of the basal ganglia in movement disorders, gait and station, coordination, deep tendon responses, bulk, tone and strength
 9. Explain how basal ganglia activity influences eye movements
 10. Describe the clinical presentation of Parkinson’s disease
 11. Describe the clinical presentation of Huntington’s disease
 12. Describe diseases involving the basal ganglia including Parkinson’s disease and Huntington’s disease.
 13. Compare and contrast the therapeutic strategies for treatment of basal ganglia disorders
 14. List the drugs commonly used in the treatment of Parkinson’s disease
 15. Discuss the therapeutic approach used in the treatment of Parkinson’s disease
 16. Discuss the involvement of the basal ganglia in non-motor diseases
- iv. **Modulation of movement by the cerebellum**
1. Explain the organization of the cerebellum including projections to and from it
 2. Diagram the circuits within the cerebellum
 3. Discuss how the cerebellum coordinates ongoing movement

4. Describe the potential clinical presentations as a consequence of a cerebellar lesion
 5. Discuss the relationship between prion disease and the cerebellum
 6. Contrast decorticate vs. decerebrate manifestations
 7. Locate and explain the function of the cerebellum, peduncles
 8. Describe the gross, internal and functional anatomy of the cerebellum
 9. Indicate the clinical findings that would indicate cerebellar pathophysiology
 10. Discuss interactions between the cerebellum and the oculomotor system
 11. Describe the manifestations of cerebellar lesions
- v. **Eye movements and sensory-motor integration**
1. Describe the innervation of the extraocular muscles
 2. List the types of eye movements and discuss each of their functions
 3. Explain the neural control of saccade eye movements
 4. Explain the neural control of smooth pursuit eye movements
 5. Explain the neural control of vergence eye movements
 6. Discuss what eye movements accomplish
 7. Explain the role of the superior colliculus in sensory motor integration
- k. **Autonomic nervous system (ANS)**
- i. Diagram the autonomic nervous system
 - ii. Label a diagram of the ANS with the mechanisms of neurotransmission used at each synapse
 - iii. Describe the brain mechanisms regulating regulation of breathing, swallowing, consciousness, feeding, sleep/wake cycles, attention
 - iv. Discuss the role of the autonomic nervous system in internal regulation
 - v. Discuss the role of the neuroendocrine systems in internal regulation
 - vi. Compare and contrast the functional organization of the autonomic and peripheral nervous systems
 - vii. List the structures innervated by the parasympathetic and sympathetic branches of the ANS
 - viii. Describe the effect of stimulation of either the parasympathetic or sympathetic nervous system on each of the target organs
 - ix. List the important therapeutic targets in the ANS and the drugs used to alter their function
 - x. Discuss the unique opportunities and challenges facing autonomic pharmacology
 - xi. Discuss the therapeutic uses of cholinomimetics and anticholinesterases
 - xii. Discuss the therapeutic uses of antimuscarinics
 - xiii. Discuss the clinical uses of neuromuscular blocking drugs
 - xiv. Discuss the therapeutic uses of sympathomimetics
 - xv. Discuss the therapeutic uses of antiadrenergics
 - xvi. Discuss the therapeutic strategies used in the treatment of disorders associated with the cardiovascular ANS (formerly a Conference)
 - xvii. Diagram the enteric nervous system
 - xviii. Discuss the interaction of the ANS, CNS, and the enteric nervous system
 - xix. Describe the sensory components of the ANS
 - xx. Explain central mechanisms regulating the ANS Identify each of the following anatomical structures, insular cortex, amygdale, hypothalamus, periaqueductal grey, parabrachial nuclei, nucleus of the solitary tract, reticular formation of the ventrolateral medulla, medial raphe nucleus, intermediolateral cell column, sympathetic ganglia, parasympathetic ganglia
 - xxi. Localize each of the following anatomical structures, insular cortex, amygdale, hypothalamus, periaqueductal grey, parabrachial nuclei, nucleus of the solitary tract, reticular formation of the ventrolateral medulla, medial

- raphe nucleus, intermediolateral cell column, sympathetic ganglia, parasympathetic ganglia
- xxii. Describe the function of each of the following anatomical structures, insular cortex, amygdale, hypothalamus, peraqueductal grey, parabrachial nuclei, nucleus of the solitary tract, reticular formation of the ventrolateral medulla, medial raphe nucleus, intermediolateral cell column, sympathetic ganglia, parasympathetic ganglia
 - xxiii. Define neuroendocrine
 - xxiv. Identify the important neuropeptides involved in thalamic, hypothalamic and pituitary function
 - xxv. Describe the roles of the thalamus, hypothalamus and pituitary in autonomic control, including, thermoregulation, food intake, osmoregulation, reproduction, stress response, reproduction, sleep wake cycle and circadian rhythms
 - xxvi. Discriminate, based on clinical findings, pituitary disorders involving prolactin, growth hormone, corticotrophin, TSH or gonadotropic hormone
 - xxvii. Describe the concept of a neighboring disorder
 - xxviii. Explain how pituitary adenomas, craniopharyngiomas and aneurysms might impact thalamic, hypothalamic and pituitary function
 - xxix. Describe Horner's syndrome
 - xxx. Discuss the role of the ANS in obesity
 - xxxi. Describe autonomic motor reflex function
 - xxxii. Explain the autonomic regulation of cardiovascular, bladder, and sexual function
 - xxxiii. Discuss the clinical presentation of generalized dysautonomia
 - xxxiv. Recognize papillary abnormalities and determine the level of the lesion based on the clinical presentation
 - xxxv. Identify sites where lesions produce bowel and bladder dysfunction

I. The changing brain

i. Early brain development

1. Describe the embryonic formation of the brain
2. Discuss the molecular mechanisms involved in neural induction
3. Discuss the promise of stem cell therapies
4. Evaluate the ethical issues related to stem cell therapies
5. Discuss retinoic acid as a teratogen and inductive signal
6. Discuss the formation of the major brain structures
7. Distinguish between cell proliferation, differentiation, maturation and senescence
8. Describe the embryological origins and destinations of the spinal and cranial nerves
9. Trace the development of the neural tube
10. Identify disorders of neural tube development
11. Discuss the role of molecular genetics in neuro-oncology
12. Apply the neurological exam to assess the status of nervous system development
13. List the genetic abnormalities affecting brain development, describe their clinical presentation and prognosis
14. Describe neurogenesis throughout the life cycle
15. Describe the process of neuronal and glial proliferation and differentiation
16. Discuss the significance of neuronal migration

ii. Neural circuit formation

1. Describe the role of the axon growth cone and non-diffusible signaling in axon guidance

2. Discuss the role of diffusible chemoattractants and chemorepellants in neural circuit formation
 3. Explain the theories related to the formation of topographic maps
 4. Describe the mechanisms involved in synapse formation
 5. Describe the role of trophic factors in establishing the size of neuronal populations
 6. Explain the significance of neurotrophin signaling
- iii. **Experience dependent modification of brain circuits**
1. Explain the concept of critical periods for neural circuit formation
 2. Use language development to illustrate the concept of critical periods in human development
 3. Describe the critical periods in the development of the visual system
 4. Explain the effects of visual deprivation on ocular dominance and amblyopia
 5. Discuss the relationship between the neuronal activity and neural circuit formation
 6. Define neural plasticity
 7. Explain the current theories concerning the cellular and molecular mechanisms of activity dependent plasticity in the nervous system
 8. List the critical periods in the development of the sensory systems
- iv. **Plasticity of mature synapses and circuits**
1. Compare and contrast short- and long-term plasticity in the nervous system
 2. Explain the molecular mechanisms underlying long-term potentiation (LTP) in the hippocampus
 3. Describe the changes in synaptic function associated with LTP
 4. Explain the function significance of LTP
 5. Compare and contrast LTP with long-term depression (LTD)
 6. Discuss the changes in gene expression occurring during LTP and LTD
 7. Discuss other brain regions where plasticity has been observed
 8. Evaluate the onset of epilepsy in the context of neural plasticity
 9. Describe the process of recovery from neural injury
- m. **Complex brain functions**
- i. **Association cortices**
 1. List the association cortices
 2. Compare the cellular organization of association cortices with primary cortices
 3. Explain the laminar structure of association cortices
 4. Identify regions of association cortices where lesions would result in deficits of attention (parietal)
 5. Identify regions of association cortices where lesions would result in deficits of recognition (temporal)
 6. Identify regions of association cortices where lesions would result in deficits of planning (frontal)
 - ii. **Language and speech**
 1. Describe the cortical distribution of language
 2. Discuss whether language is lateralized
 3. Explain the anatomical and functional differences in right and left hemispheres
 4. Consider the relationship between language and handedness
 5. Compare and contrast the cortical representations of spoken vs. sign language
 - iii. **Sleep and wakefulness**
 1. Diagram the neural circuits involved in sleep and wakefulness

2. Explain the functional role of sleep
3. Discuss the circadian cycle of sleep and wakefulness
4. List the sleep states
5. Describe the physiological changes occurring in the different sleep states
6. Identify each of the following anatomical structures, insular cortex, amygdale, hypothalamus, aqueductal grey, parabrachial nuclei, nucleus of the solitary tract, reticular formation of the ventrolateral medulla, medial raphe nucleus, intermediolateral cell column, sympathetic ganglia, parasympathetic ganglia
7. Localize each of the following anatomical structures, insular cortex, amygdale, hypothalamus, aqueductal grey, parabrachial nuclei, nucleus of the solitary tract, reticular formation of the ventrolateral medulla, medial raphe nucleus, intermediolateral cell column, sympathetic ganglia, parasympathetic ganglia
8. Describe the function of each of the following anatomical structures, insular cortex, amygdale, hypothalamus, aqueductal grey, parabrachial nuclei, nucleus of the solitary tract, reticular formation of the ventrolateral medulla, medial raphe nucleus, intermediolateral cell column, sympathetic ganglia, parasympathetic ganglia
9. Identify the anatomical structures involved in consciousness, including reticular formation, cholinergic and monoaminergic networks, thalamic nuclei, important ascending projections, cerebral cortex
10. Illustrate the major connections to and from the reticular formation
11. Describe the role of the reticular formation in consciousness
12. Contrast the electrical activity of single neurons and neuronal aggregates
13. Explain the neurophysiological basis of the EEG
14. Describe the electrophysiology of cortical neurons as pertains to the EEG
15. Describe the physiological modulation of cortex and basal ganglia
16. Explain the origin of cortical seizures
17. List the classes of antiepileptic drugs
18. Discuss the diagnosis of epilepsy and the therapeutic approach to the treatment of epilepsy in adolescents, adults and the elderly
19. Describe the important brainwave patterns recorded with the EEG
20. Correlate the stages of sleep, REM and the associated EEG brainwave patterns
21. Discuss the anatomic substrates related to sleep
22. Discriminate the pathologies affecting consciousness, including, narcolepsy, REM, sleep behavior disorders, confusional states (encephalopathy), coma, concussion, seizures, syncope, loss of consciousness, EEG
23. Discuss the possible functions of REM sleep and dreaming
24. Discuss hypnotics and stimulants

iv. Emotions

1. Discuss the neurophysiological changes associated with emotion
2. Diagram the neural pathways involved in the integration of emotion
3. Compare and contrast the roles of the amygdala and limbic systems in emotion
4. Describe the relationship between the neocortex and amygdala as pertains to emotion
5. Describe the cortical location of emotional functions
6. Discuss the interrelationships of emotion, reason and social behavior
7. Discuss the mechanisms of action of the most commonly prescribed antidepressant drugs

8. Discuss the clinical considerations when prescribing antidepressant drugs and mood stabilizers
 9. Discuss the mechanisms of action of the most commonly prescribed antipsychotic drugs
 10. Discuss the clinical considerations when prescribing antipsychotic drugs
 11. Discuss the mechanisms of action of the most commonly prescribed psychomotor stimulants
 12. Discuss the clinical considerations when prescribing psychomotor stimulants
 13. Discuss the mechanisms of ethanol addiction
 14. Describe the psychosocial aspects of alcohol abuse and addiction
 15. Develop a theory which unifies the physiological, pharmacological and psychiatric aspects of addiction
- v. **Sex, sexuality and the brain**
1. List the important sexually dimorphic behaviors
 2. Discuss the hormonal influences on sexual dimorphism
 3. Describe the effects of sex hormone on neural circuitry function
 4. Discuss central nervous system dimorphisms as specifically relates to reproductive behaviors
 5. Discuss central nervous system dimorphisms as specifically relates to cognitive function
- vi. **Memory**
1. Define the qualitative categories of human memory
 2. Describe the anatomy and physiology of the limbic system, particularly the amygdale
 3. Discuss clinical presentations that would indicate limbic system/amygdale involvement
 4. Discuss the functional organization of the hippocampus
 5. Explain the role of the hippocampus in memory
 6. Discuss the anatomical substrates involved in memory
 7. Compare and contrast the different types of memory, declarative, working, long term, immediate
 8. Define amnesia
 9. Explain how retrograde and anterograde amnesia could be discriminated in a clinical evaluation
 10. Discuss the temporal categories of memory
 11. Discussion the importance of association in information storage
 12. Discuss theories related to the cellular basis for learning and forgetting
 13. Diagram the brain systems underlying declarative memory formation
 14. Diagram the brain systems underlying long-term storage of declarative memory
 15. Describe the brain systems underlying nondeclarative learning and memory
 16. Discuss the relationship between aging and memory
 17. Describe the clinical presentation of Alzheimer's disease
 18. Discuss the available drug therapies for Alzheimer disease

Appendix A: Psychiatry Major Content Area Objectives

Introduction to Clinical Psychiatry

1. Define the discipline of psychiatry and modern clinical practice.
2. Define and distinguish between various major biological, psychological, and social theories of mind and mental illness.

3. Describe the individual and socioeconomic impact of mental illness (nationally and globally).
4. Describe the impact of modern health care systems and their impact on the treatment of those suffering from mental illness.
5. Describe the impact of sociocultural factors on the diagnosis and treatment of mental illness.

Psychiatric Diagnosis and Treatment Formulation

1. Describe the historical development of psychiatric nosology in the 19th and 20th centuries.
2. Describe the development and current use of the Diagnostic and Statistical Manual-DSM.
3. Define and describe the elements of a modern multiaxial diagnostic formulation.
4. Define the concept of biopsychosocial evaluation and treatment formulation.

Child and Adolescent Psychiatry

Cognitive and Learning Impairment (*mental retardation & learning disorders*)

1. Describe and distinguish between healthy and disordered forms of eating.
2. Describe and distinguish between the diagnostic criteria for the eating disorders.
3. Describe the current pathophysiological understanding of the development of the eating disorders.
4. Recognize and describe the common clinical presentations of the eating disorders.
5. Describe the elements of a thorough diagnostic evaluation of the eating disorders.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated (and comorbid) with the development of eating disorders.
7. Describe the major demographic and epidemiological factors related to the development of the eating disorders.
8. Describe the major forms of treatment for the eating disorders and their known efficacies.

Developmental Impairment (*autism/PDDS; motor and communication disorders*)

1. Describe the various types of developmental impairments which may develop in children and adolescents. Distinguish these impairments from normal emotional and cognitive development.
2. Describe and distinguish between the diagnostic criteria for the various developmental disorders of childhood and adolescence.
3. Describe the current pathophysiological understanding of the various developmental disorders of childhood and adolescence.
4. Recognize and describe the common clinical presentations of the developmental disorders of childhood and adolescence.
5. Describe the elements of a thorough diagnostic evaluation of the developmental disorders of childhood and adolescence.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated (and comorbid) with the development of the developmental disorders of childhood and adolescence.
7. Describe the major demographic and epidemiological factors related to the developmental disorders of childhood and adolescence.
8. Describe the major forms of treatment for the developmental disorders of childhood and adolescence.

Behavioral Impairment (*ADHD; disruptive behaviors; tic disorders; elimination; separation anxiety; reactive attachment*)

1. Describe and distinguish between different forms of normal and disruptive behavior in children and adolescents.
2. Describe and distinguish between the diagnostic criteria for disorders of disruptive behavior in childhood and adolescence.
3. Describe the current pathophysiological understanding of the disorders of disruptive behavior in childhood and adolescence.
4. Recognize and describe the common clinical presentations of the disorders of disruptive behavior in childhood and adolescence.

5. Describe the elements of a thorough diagnostic evaluation of disruptive behavior in children and adolescents.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated (and comorbid) with the development of the disorders of disruptive behavior in children and adolescents.
7. Describe the major demographic and epidemiological factors related to the development of the disorders of disruptive behavior in children and adolescents.
8. Describe the major forms of treatment for the disorders of disruptive behavior in children and adolescents and their known efficacies.

Disordered Eating

1. Describe and distinguish between healthy and disordered forms of eating.
2. Describe and distinguish between the diagnostic criteria for the eating disorders.
3. Describe the current pathophysiological understanding of the development of the eating disorders.
4. Recognize and describe the common clinical presentations of the eating disorders.
5. Describe the elements of a thorough diagnostic evaluation of the eating disorders.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated (and comorbid) with the development of eating disorders.
7. Describe the major demographic and epidemiological factors related to the development of the eating disorders.
8. Describe the major forms of treatment for the eating disorders and their known efficacies.

Adult Psychiatry

Psychosis

1. Define the concept of psychosis and how it differs from normal cognitive and sensory experiences.
2. Describe the different cognitive and sensory forms of psychosis.
3. Describe and distinguish between the diagnostic criteria for psychotic episodes and disorders.
4. Describe the current pathophysiological understanding of the development of psychotic episodes and disorders.
5. Recognize and describe the common clinical presentations of psychotic episodes and disorders.
6. Describe the elements of a thorough diagnostic evaluation of psychotic episodes and disorders.
7. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of psychotic episodes and disorders.
8. Describe the major demographic and epidemiological factors related to the development of psychotic episodes and disorders.
9. Describe the major forms of treatment for psychotic episodes and disorders and their known efficacies.

Depression

1. Define the concept of depression.
2. Describe and distinguish between the diagnostic criteria of depressive episodes and disorders.
3. Describe the current pathophysiological understanding of the development of depressive episodes and disorders.
4. Recognize and describe the common clinical presentations of depressive episodes and disorders.
5. Describe the elements of a thorough diagnostic evaluation of depressive episodes and disorders.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of depressive episodes and disorders.
7. Describe the major demographic and epidemiological factors related to the development of depressive episodes and disorders.
8. Describe the major forms of treatment for depressive episodes and disorders and their known efficacies.

Mania

1. Define the concepts of hypomania, mania, and mixed states.
2. Describe and distinguish between the diagnostic criteria for hypomanic, manic, and mixed episodes.
3. Describe the current pathophysiological understanding of the development of hypomanic, manic, and mixed states.
4. Recognize and describe the common clinical presentations of hypomanic, manic and mixed states.
5. Describe the elements of a thorough diagnostic evaluation of hypomanic, manic and mixed states.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with hypomanic, manic, and mixed episodes.
7. Describe the major demographic and epidemiological factors related to hypomania, mania, and mixed episodes.
8. Describe the major forms of treatment for hypomania, mania, and mixed episodes and their known efficacies.

Anxiety

1. Define and distinguish between the concepts of anxiety and pathological anxiety.
2. Describe and distinguish between the diagnostic criteria of the anxiety disorders.
3. Describe the current pathophysiological understanding of the development of anxiety and the anxiety disorders.
4. Recognize and describe the common clinical presentations of anxiety and the anxiety disorders.
5. Describe the elements of a thorough diagnostic evaluation of anxiety and the anxiety disorders.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of anxiety and the anxiety disorders.
7. Describe the major demographic and epidemiological factors related to the development of the anxiety disorders.
8. Describe the major forms of treatment for the anxiety disorders and their known efficacies.

Trauma

1. Define the concepts of emotional, physical, and sexual trauma and traumatic exposure.
2. Describe and distinguish between normative and pathological responses to various forms of trauma.
3. Describe the current pathophysiological understanding of the development of traumatic disorders.
4. Describe and distinguish between the diagnostic criteria for various traumatic disorders.
5. Recognize and describe the common clinical presentations of the traumatic disorders.
6. Describe the elements of a thorough diagnostic evaluation of the traumatic disorders.
7. Describe the various psychiatric, medical, and substance use illnesses associated (and comorbid) with the development of traumatic disorders.
8. Describe the major demographic and epidemiological factors related to the development of traumatic disorders.
9. Describe the major forms of treatment for the traumatic disorders and their known efficacies.

Addiction

1. Define and distinguish between the concepts of substance use, abuse, dependency, and addiction.
2. Define and distinguish between different theories of addiction.
3. Describe the impact of substance use disorders on individuals and society.
4. Recognize, describe, and distinguish between the major addictive substances and their syndromes of dependency, intoxication and withdrawal.
5. Describe the elements of a thorough diagnostic evaluation of the substance use disorders.
6. Describe the major forms of substance use disorders treatment and their known efficacies.

Interpersonal/Relational Issues

1. Define and distinguish between healthy and impaired relationships in children and adults.
2. Describe and distinguish between the diagnostic criteria for relational illnesses in children and adults.
3. Describe the current pathophysiological understanding of the development of the relational disorders.
4. Recognize and describe the common clinical presentations of the relational disorders.
5. Describe the elements of a thorough diagnostic evaluation of the relational disorders
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of the relational disorders.
7. Describe the major demographic and epidemiological factors related to the development of the relational disorders.
8. Describe the major forms of treatment for the relational disorders and their known efficacies.

Somatization

1. Define the concept of somatization.
2. Describe and distinguish between the diagnostic criteria of the somatization and related disorders.
3. Describe the current pathophysiological understanding of the development of somatization and related disorders.
4. Recognize and describe the common clinical presentations of somatization and related disorders.
5. Describe the elements of a thorough diagnostic evaluation of the somatization and related disorders.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of somatization and related disorders.
7. Describe the major demographic and epidemiological factors related to the development of the somatization and related disorders.
8. Describe the major forms of treatment for the somatization and related disorders and their known efficacies.

Impulsive Behavior

1. Define the concept of impulsivity in children and adults.
2. Describe and distinguish between the diagnostic criteria for disorders of impulsivity and impulse control in children and adults.
3. Describe the current pathophysiological understanding of the development of impulse impulsivity and impulse control disorders in children and adults.
4. Recognize and describe the common clinical presentations of impulsivity and impulse control disorders in children and adults.
5. Describe the elements of a thorough diagnostic evaluation of impulse control disorders in children and adults.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of impulsive episodes and impulse control disorders in children and adults.
7. Describe the major demographic and epidemiological factors related to the development of impulse control disorders in children and adults.
8. Describe the major forms of treatment for impulse control disorders in children and adults and their known efficacies.

Self Harm and Suicide

1. Define the concepts of suicide and parasuicidal behavior.
2. Describe the impact of attempted and completed suicide on individuals, families and society.
3. Describe the major psychiatric, medical, and substance use disorders associated with suicide.

4. Describe the major demographic and epidemiological factors related to attempted and completed suicide.
5. Describe the major known risks and protective factors related to suicide.
6. Explain the evaluative elements performed in a comprehensive suicide risk assessment.
7. Describe the clinical and legal interventions available to reduce the risk of completed suicide.

Violence

1. Define the concept of violence.
2. Describe the impact of violence on individuals, families, and society.
3. Describe the major psychiatric, medical, and substance use disorders associated with violence.
4. Describe the major demographic and epidemiological factors related to the commission of violent acts.
5. Describe the major known risks and protective factors related to violence.
6. Explain the evaluative elements performed in a comprehensive violence risk assessment.
7. Describe the clinical and legal interventions available to reduce the risk of violence.

Sexuality/Gender Issues

1. Define and distinguish between the major theories and concepts of gender and sexual identity.
2. Describe the effect of biological, historical, and sociocultural factors on the development of sexual and gender identity.
3. Define and distinguish between theories of healthy and disordered sexuality and gender identity.
4. Describe and distinguish between currently accepted diagnostic criteria for sexual and gender identity disorders.
5. Recognize and describe the common clinical presentations of sexual and gender identity disorders.
6. Describe the elements of a thorough diagnostic evaluation of sexual and gender identity disorders.
7. Describe the major demographic and epidemiological factors related to the development of the sexual and gender identity disorders.
8. Describe the major forms of treatment for sexual and gender identity disorders, their known efficacies, and existing controversies in the field.

Sleep

1. Define and distinguish between the concepts of normal sleep, insomnia, parasomnia, and dyssomnia.
2. Describe and distinguish between the diagnostic criteria of the sleep disorders.
3. Describe the current pathophysiological understanding of the development of sleep disorders.
4. Recognize and describe the common clinical presentations of sleep disorders.
5. Describe the elements of a thorough diagnostic evaluation of sleep disorders.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of sleep disorders.
7. Describe the major demographic and epidemiological factors related to the development of the sleep disorders.
8. Describe the major forms of treatment for the sleep disorders and their known efficacies.

Dissociation

1. Define the concept of dissociation.
2. Describe and distinguish between the diagnostic criteria of the dissociative disorders.
3. Describe the current pathophysiological understanding of the development of dissociative disorders.
4. Recognize and describe the common clinical presentations of the dissociative disorders.
5. Describe the elements of a thorough diagnostic evaluation of dissociative disorders.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of dissociation and dissociative disorders.

7. Describe the major demographic and epidemiological factors related to the development of the dissociative disorders.
8. Describe the major forms of treatment for the dissociative disorders and their known efficacies.

Impaired Cognition and Amnesia

1. Define and distinguish between the concepts of normal and impaired cognition and amnesia in adults.
2. Describe and distinguish between the diagnostic criteria of the various cognitive and amnesic disorders in adults.
3. Describe the current pathophysiological understanding of the development of cognitive impairment and the cognitive and amnesic disorders in adults.
4. Recognize and describe the common clinical presentations of cognitive impairment and cognitive and amnesic disorders in adults.
5. Describe the elements of a thorough diagnostic evaluation of cognitive impairment and cognitive and amnesic disorders in adults.
6. Describe and distinguish between the various psychiatric, medical, and substance use illnesses associated with the development of cognitive impairment and cognitive and amnesic disorders in adults.
7. Describe the major demographic and epidemiological factors related to the development of the cognitive impairment and cognitive and amnesic disorders in adults.
8. Describe the major forms of treatment for the cognitive impairment and cognitive and amnesic disorders in adults and their known efficacies.

Appendix B: Neurology Major Content Area Objectives

Cranial nerves

1. Cite all 12 cranial nerves by number
2. Describe the motor function of CN's 9, 10, 11, 12
3. Describe the sensory function of CN's 9, 10, 11, 12
4. Describe the special sensation conveyed by CN's 9, 10, 11, 12
5. Describe whether CN's 9, 10, 11, 12 carry a reflex arc, and whether it is afferent or efferent

Motor Neuron Disease

1. Describe the clinical manifestations of ALS
2. Describe the etiology, pathogenesis and pathophysiology of ALS
3. Describe the differential diagnosis of ALS
4. Describe the diagnostic evaluation, prognosis, and management of ALS
5. Describe the lower motor neuron in relation to corticospinal tracts
6. Describe the concept of an upper motor neuron
7. List the neurological exam findings observed when a lesion affects both the lower and upper motor neurons
8. Extract from clinical vignettes signs and symptoms that describe UMN and LMN lesions
9. Localize potential sites of lesions when either UMN or LMN exam findings are seen

Hearing and Balance

1. Discuss the two major functions of the 8th cranial nerve.
2. Describe how to screen audition
3. Perform and correctly interpret findings from Rinne and Weber testing
4. Interpret exam findings in sensorineural and air conduction hearing loss types
5. Describe how to perform the Dix Hallpike maneuver

Dementia

1. Describe how to recognize dementia and distinguish it from delirium, mild cognitive impairment and normal aging
2. Outline the methods and unique requirements of dementia evaluations

3. Identify the typical and atypical features of common and a few distinctive dementing diseases
4. Describe how to recognize dementia and distinguish it from delirium, mild cognitive impairment and normal aging
5. Outline the methods and unique requirements of dementia evaluations
6. Identify the typical features and typical features of common and a few distinctive dementing

Optic nerve and disc

1. Be able to determine the cup to disc ratio
2. Recognize a cilioretinal artery
3. Recognize papilledema
4. Know how to use the different dials of the ophthalmoscope
5. Know common variants of the disc

Eye movement and nystagmus

1. Know the principal disorders of ocular motility
2. Identify III, IV, VI N palsies, and their etiologies
3. List the anatomic locations where nystagmus can be localized
4. Recognize down-beat and up-beat nystagmus

Trauma

1. Understand the different anatomic types of cranial trauma, their radiologic appearance on CT, and their common clinical presentations.
2. Understand how to assess a victim of traumatic brain injury, determine level of consciousness and signs of herniation
3. Describe how to initially stabilize trauma patients with severe head injury and provide empiric treatment for elevated intracranial pressure.
4. Describe how to work up patient with suspected head trauma
5. Describe the clinical and radiologic features of chronic subdural hematoma
6. Understand the differences between primary and secondary tissue injury, the main causes of secondary injury and treatments to prevent secondary injury

Headache

1. Know the 5 histories to take on every patient with headache
2. Differentiate between pain-sensitive and pain-insensitive structures
3. Know the different types of primary headache.
4. Know the difference between primary and secondary Headache
5. Know the clinical features of headaches due to temporal arteritis, brain tumors, and meningitis
6. Describe the current understanding of the pathophysiology of migraine
7. List drugs commonly used for prevention and acute treatment of migraine
8. Describe the mechanism of action of common headache drugs
9. List contraindications to triptans
10. Describe ergotism; serotonin syndrome

Multiple sclerosis

1. Describe the clinical manifestations of MS
2. Describe the etiology, pathogenesis and pathophysiology of MS
3. Describe the differential diagnosis of MS
4. Describe the diagnostic evaluation, prognosis, and management of MS

Sensory function

1. Draw the two major ascending sensory pathways
2. List which sensory modalities each of the two major ascending pathways convey
3. List where each of the two major ascending pathways decussate
4. Localize lesions on the X-Y axis based upon your understanding of the two ascending sensory pathways

Muscle disease

1. Diagnose the 4 major muscular dystrophies by phenotype
2. Diagnose the 2 major inflammatory myopathies (polymyositis and dermatomyositis) by phenotype
3. Describe tests which may be utilized to arrive at a diagnosis for all of the muscle disorders described in this handout
4. Describe the clinical hallmarks of the aforementioned disorders

Neuromuscular junction

1. Diagnose the 2 major disorders of the NMJ by phenotype
2. Describe whether the autoimmune attack is pre- or post-synaptic for both MG and LEMS
3. Describe the epitopes targeted for both MG and LEMS
4. Describe which type of malignancy is associated with MG and LEMS
5. Describe how electrodiagnostic test results (EMG) vary between both MG and LEMS
6. Describe how the edrophonium (Tensilon) test works
7. Diagnose the 2 major disorders of the neuromuscular junction by phenotype
8. Describe tests which may be utilized to arrive at a diagnosis for disorders of the NMJ
9. Describe the clinical hallmarks of the aforementioned disorders

Peripheral nervous system

1. Identify a key muscle in the arm/hand for myotomes C5, C6, C7, C8
2. Perform manual motor testing on yourself for each myotome listed
3. Draw on yourself the dermatome for spinal levels C5-T1
4. Draw on yourself the sensory distribution for the ulnar, median, and radial nerves
5. Identify key manual motor testing for the median, ulnar and radial nerves
6. Differentiate lesions in the spinal cord, spinal nerve root, plexus, and peripheral nerve

Movement disorders

1. Learn the basic terms used to describe abnormal movements (chorea, tremor, dystonia, tics, etc.).
2. Recognize the clinical features of Parkinson's disease and be familiar with the appropriate pharmacologic interventions for this condition
3. Distinguish between the tremors from cerebellar disease and basal ganglia pathology.
4. Diagnose essential tremor, the resting tremor of Parkinson's Disease, and a cerebellar ataxic tremor based upon a neurological examination
5. Know how to identify abnormal movements by sight
6. Know the definition of the abnormal movements as described in the handout by Dr. Renner
7. Know the classic exam findings in the following disorders:
 - a. Parkinson's Disease
 - b. Huntington's Disease
 - c. Cerebellar hemisphere lesions
 - d. Essential Tremor
 - e. Tourette's Syndrome
 - f. Dystonia
 - g. Tic
 - h. Myoclonus
 - i. Ballismus
8. Know how these various disorders are treated, both pharmacologically and non-pharmacologically
9. Know the side effects of medications used to treat medications
10. Know how these side effects are counter-acted

Seizures

1. Understand the definitions of seizure, epilepsy, and other terms related to this topic
2. Know the demography/epidemiology of seizures and epilepsy
3. Understand the different types of seizures
4. Recognize the key features distinguishing partial from generalized seizures
5. Understand how these differences impact choice of treatment
6. Recognize the cardinal of features of 3 key epileptic syndromes

7. Understand the diagnostic approach to seizures
8. Understand the basics of treatment of epilepsy with antiepileptic drugs (AEDs)
9. Understand the main mechanisms of action of AEDs
10. Understand basic pharmacokinetics, adverse reactions and clinical profiles of commonly prescribed AEDs

Sleep

1. Review the general categories and importance of sleep disorders
2. Introduce basic sleep physiology and pathologies associated with sleep stages
3. Outline the Sleep Laboratory measurement of sleep pathology
4. Discuss pathophysiology of, and clinical approach to, Narcolepsy & Restless Legs Syndrome

Stroke

1. Understand the types and mechanisms of stroke.
2. Know the clinical syndromes of stroke
3. Determine the acute treatment of ischemic stroke
4. Memorize risk factors of stroke.
5. Define recommended prevention treatments for stroke

Tourette Syndrome

1. Diagnose the clinical hallmark of Tourette Syndrome
2. Describe potential causes of Tourette Syndrome
3. Describe which neurotransmitter is most often implicated in this disorder
4. Describe its estimated prevalence
5. List a differential diagnosis of this movement disorder
6. List pharmacological therapies for Tourette Syndrome

Visual acuity

1. Know what Snellen acuity means
2. Know the pattern of visual field defects and their neuro- anatomical localization.
3. Know the pathways for pupillary responses—sympathetic and parasympathetic
4. Describe relative afferent pupillary defect
5. Know how to diagnose a Horner's Syndrome; pre and post-ganglionic Horner's syndrome and Adies Syndrome
6. Develop an approach anisocoria?
7. List the causes of light near dissociation?

Coma

1. Try to maintain an optimal level of consciousness during this lecture.
2. Understand the basic pathophysiologic mechanisms of impaired consciousness. Distinguish between "structural" and "metabolic" causes/manifestations of coma.
3. Be familiar with the basic evaluation of the comatose patient.
4. Memorize an algorithm for management of a comatose patient.

Dementia

1. Describe how to recognize dementia, and distinguish it from delirium, mild cognitive impairment, and normal aging.
2. Outline the methods and unique requirements of dementia evaluations
3. Describe how dementia affects members of the family
4. Describe the psychosocial aspects of dementia in the lives of patients

MiniMental Status Exam

1. List the four major localizable cognitive domains
2. Describe the deficits seen in each domain
3. Describe where each domain localizes
4. Describe a bedside test that assesses each of the four major localizable cognitive domains

5. Understand the differences between aphasia, apraxia, agnosia

Head trauma

1. Understand the different anatomic types of cranial trauma, their radiologic appearance on CT, and their common clinical presentations.
2. Understand how to assess a victim of traumatic brain injury, determine level of consciousness and signs of herniation.
3. Describe how to initially stabilize trauma patients with severe head injury and provide empiric treatment for elevated intracranial pressure.
4. Describe how to work up patient with suspected head trauma.
5. Describe the clinical and radiologic features of chronic subdural hematoma.
6. Understand the differences between primary and secondary tissue injury, the main causes of secondary injury and treatments to prevent secondary injury.

Pain

1. Identify structures of the pain sensory system (central and peripheral) that may be lesioned to produce pain syndromes
2. Describe the underlying pathophysiology of disorders which are painful
3. Based upon an understanding of pathophysiology, describe pharmacologic and non-pharmacologic therapies which can address pain syndromes
4. Describe the treatments of acute and chronic pain

Cortical function and localization

1. Describe the classic findings when lesions affect the right and left cortices of each of the 4 lobes of the brain
2. Describe how to localize a lesion on the vertical Y axis of the central nervous system
3. Describe how to localize a lesion on the horizontal X axis of the central nervous system
4. Describe where the somatosensory tracts decussate in the Y axis
5. Describe where the corticospinal tracts decussate in the Y axis

CNS Infections

1. Know the characteristic clinical presentation of meningitis and encephalitis
2. Know the cerebral spinal fluid (CSF) profiles of CNS infections
3. Know the most likely bacteria by age and exposure
4. Know the most likely viruses by exposure
5. Know the likely agents in immunocompromised patients

Cerebrospinal fluid analysis

1. List the classic CSF profile (cell count, glucose, and protein) in CNS infections caused by:
 - a. Bacteria
 - b. Fungus
 - c. Virus
 - d. Guillain Barre Syndrome
 - e. Cancer
 - f. Intracranial hemorrhage
 - g. Tuberculosis
 - h. Multiple sclerosis

Coma

1. Understand the basic pathophysiologic mechanisms of impaired consciousness.
2. Distinguish between structural and metabolic causes of coma.
3. Be familiar with the basic evaluation of the comatose patient.
4. Memorize an algorithm for management of a comatose patient.

Gait

1. Identify the salient components of normal stride and gait

2. Identify abnormal gait patterns
3. Distinguish gait patterns related to lesions in the nervous system
 - a. festinating gait of Parkinsons disease
 - b. spastic gait of spastic paraparesis
 - c. slap foot gait of bilateral foot drop
 - d. circumducting gait of hemiparesis
 - e. waddling gait of myopathies
 - f. ataxic gait of cerebellar disease
 - g. dystonic gait of basal ganglia pathology
 - h. scissoring gait of spasticity
 - i. affected gait of conversion disorder

Appendix C: Brain and Behavior Toolbox

1. Clinical Neurology
 - a. Brain
 - i. X-ray
 - ii. CT
 - iii. MRI
 - iv. EEG
 - v. PET
 - vi. SPECT
 - vii. Polysomnography
 - viii. Transcranial Doppler ultrasound
 - ix. Evoked potentials
 1. visual (V-EP)
 2. brainstem auditory (BA-EP)
 - x. CSF analysis
 1. manometry
 2. visual inspection
 3. cell count and differential
 4. protein
 5. glucose
 6. culture (viral, fungal, bacterial)
 - 7.
 - b. Spinal cord
 - i. X-ray
 - ii. CT
 - iii. MRI
 - iv. Myelography
 - v. Evoked potentials
 1. somatosensory (SSEP)
 - vi. CSF analysis
 - c. Peripheral nerve roots, plexus, nerve
 - i. Nerve conduction studies/EMG
 - ii. Biopsy
 - iii. CSF analysis
 - d. Neuromuscular junction
 - i. Antibodies
 1. Ach-receptor
 2. Voltage-gated calcium ion channel
 - ii. Nerve conduction studies
 1. repetitive stimulation
 - e. Muscle
 - i. Creatine kinase (CK)
 - ii. EMG

- iii. Biopsy
 - f. Vasculature
 - i. CT-angiography
 - ii. CT-venography
 - iii. CT-perfusion
 - iv. MR-angiography
 - v. MR-venography
 - vi. MR-perfusion
 - vii. Ultrasound
 - 1. cardiac and aortic arch
 - 2. carotid artery
 - 3. vertebral artery
 - viii. Conventional cerebral angiography
 - ix. Biopsy
- 2. Psychiatry

- n. Psychiatry: demonstrate an understanding of the current scientific knowledge base regarding the major mental illnesses, their clinical presentations, and the practice of psychiatric medicine:
 - i. Define and distinguish between the major theories of mental illness and how they differ from normal emotional, physical, cognitive and sensory functioning and experiences.
 - ii. Describe distinguish between the major classes of mental illness.
 - iii. Describe and distinguish between the diagnostic criteria within and between the major classes of mental illness.
 - iv. Describe the current pathophysiological understanding of the development of the major mental illnesses.
 - v. Recognize and describe the common clinical presentations of the major mental illnesses.
 - vi. Describe the elements of a thorough diagnostic evaluation of the major mental disorders.
 - vii. Describe and distinguish between the various comorbid or contributing psychiatric, medical, and substance use illnesses associated with the development of the major mental disorders.
 - viii. Describe the major demographic and epidemiological factors related to the development of the major mental illnesses.
 - ix. Describe the common forms of treatment for the major mental illnesses and their known risks, benefits and efficacies.
 - x. (see appendix A)

Clinical Neurology and Neurosurgery

1. Describe the 10 natural divisions of the neuraxis
2. Elicit a neurological history
3. Recognize patient symptoms referable to each level of the neuraxis
4. Recognize normal and abnormal clinical exam signs referable to each level of the neuraxis
5. Perform a neurological exam in entirety
6. List the major clinical disorders which localize to the various 10 divisions of the neuraxis
7. Identify the major neurological disorders which affect more than one level of the neuraxis
8. Generate a differential diagnosis for elicited exam signs and clinical symptoms
9. Generate treatment options, both pharmacological and nonpharmacological, for the clinical disorders which localize to the various divisions of the neuraxis
10. Describe the pathophysiology which underlies the major neurological disorders
11. Describe the genetic, epidemiologic, and demographic factors related to neurological disease
12. Describe how the nervous system ages, and how various neurological disorders stratify through the continuum of life

head trauma

1. concussion
2. contusion
3. penetrating brain injuries

Raised intracranial pressure

1. signs of raised intracranial pressure
2. brain tumors
 - a. signs
 - b. symptoms
 - c. differential diagnosis
3. hydrocephalus

Infectious diseases of the brain and its coverings

1. meningitis
 - a. acute purulent
 - b. aseptic / lymphocytic
 - c. chronic
2. encephalitis
 - a. viral
 - b. fungal
 - c. protozoal
 - d. bacterial
 - e. secondary to immune reaction
3. syphilis
 - a. general aspects and terminology
 - b. diagnosis
 - c. tabes dorsalis
 - d. general paresis
4. brain abscess
5. epidural abscess and subdural empyema
6. intra-uterine

cerebral palsy

coma and confusion

cerebrovascular disease

movement disorders

cerebellar disease and ataxia

neurodegenerative disorders

dementia

amyotrophic lateral sclerosis

sleep disorders

neuro-oncology

peripheral neuropathy

neuromuscular junction disease

muscle disease

spinal cord disorders

epilepsy

pain

inflammatory disorders

headache

neuro-ophthalmology

neuro-otology: dizziness and hearing loss

neurorhabilitation

Created on 2/3/2009 8:55:00 PM