3 credit hours

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**Time/Place:**

**Course Prerequisites** : CSD 251: Anatomy and Physiology for Speech Language Pathologists or Equivalent

**Course Description:** Application of the principles of neuroanatomy and neurophysiology to the study of normal human communication**.**

**Learner (Course) Objectives:**

**COURSE GOALS:**

1. Students will apply the principles involved in the study of normal human neural functions to human communication systems.

2. Students will synthesize an integrated concept of communicative functions from knowledge about the form and function of the human nervous system.

3. Students will relate key facts about the function of the neuron, including action potential, excitability, conductivity, and pooling to communicative processes.

4. Each student will perform a cranial nerve screening under observation and verbally describe its application to the evaluation of upper and lower motor neuron function in evaluation of communicative functions.

**Outcome Measures:**

1. Students will respond to section test items with 70% or greater accuracy.

2. Students will perform, under observation, a successful cranial nerve screening on fellow classmates.

3. Students will apply screening responses of their fellow classmates to communication evaluation by responding accurately to randomly posed questions presented by the observer.

4. Students will formulate written questions which apply articles in the supplemental reading list to the study of human nervous system functions in communication.

### Course Structure/approach: CSD 405 is oriented to application of instruction, demonstration and display to problem solving about human neural processes involved in communication. Material will be presented through lectures and readings, with concepts developed through classroom discussion and demonstrations. All students are encouraged and expected to participate in the classroom discussions.

**SUGGESTED Texts:**

There is no required text for this course. Students can earn top marks by studying the online lecture notes, following posted links, reading the journal articles and actively searching the Web for further information on critical items. For students who need direction, the following texts are recommended.

Bhatnagar, S. (2012). *Neuroscience for the study of communicative disorders (4th Edition).* Baltimore, MD: Williams & Wilkins.

Bear, M.F., Connors, B.W. and Paradiso, M.A. (2015). *Neuroscience: exploring the brain (4th Edition).* Baltimore, MD: Williams and Wilkins.

**CURRENT LITERATURE REVIEW LIST:**

Students are responsible for reading selected current literature. Copies of the following articles are available on line through the Cline Library web site.

**Please see directions for completing the literature review in this syllabus.**

***REQUIRED READING:***

Bonilha, L., Hillis, A.E., Hickok, G., den Ouden, D.B., Rorden, C. & Fridriksson, J. (2017). Temporal lobe networks supporting the comprehension of spoken words, *Brain,* awx169. https://doi.org/10.1093/brain/awx169

Stewart, E., Catroppa, C., & Lah, S. (2016). Theory of mind in patients with epilepsy: A systematic review and meta-analysis. *Neuropsychology Review, 26*, 3-24.

doi:10.1007/s11065-015-9313-x

Eres, R., Decety, J., Louis, W.R. & Molenberghs, P. (2015).Individual differences in local gray matter density are associated with differences in affective and cognitive empathy. *Neuroimage, 117,* 305-310.

http://www.sciencedirect.com/science/article/pii/S1053811915004206#

Flinker, A., Korzeniewska, A., Shestyuk, A.Y., Franaszczuk, P.J., Dronkers, N.F., Knight, R.T., & Crone, N.E. (2015). Redefining the role of Broca’s area in speech.*Proceedings of the National Academy of Sciences, USA, 112,* 2871-2875.doi:10.1073/pnas.1414491112

Mazoyer B., Zago, L., Jobard, G., Crivello, F., Joliot, M., Perchy, G., … Tzourio-Mazoyer, N. (2014). Gaussian mixture modeling of hemispheric lateralization for language in a large sample of healthy individuals balanced for handedness. *PLOS ONE 9*(6): e101165. doi:10.1371/journal.pone.0101165

*RECOMMENDED:*

Bouchard, K.E., Mesgarani, N, Johnson, K., & Chang, E. (2013). Functional organization of human sensorimotor cortex for speech articulation. Nature, 495, 327-332. doi:10.1038/nature/11911

Han, X., Chen, M., Wang, F., Windrem, M., Wang, S., Shanz, S., … Nedergaard, M. (2013). Forebrain engraftment by human glial progenitor cells enhances synaptic plasticity and learning in adult mice. *Cell Stem Cell*, 342-353.

Evans, T. M., Flowers, D. L., Napoliello, E. M., & Eden, G. F. (2013). **Sex-specific gray matter volume differences in females with developmental dyslexia**. Brain Structure and Function, *219*, 1041-1054. doi: [10.1007/s00429-013-0552-4](http://dx.doi.org/10.1007/s00429-013-0552-4)

Andrews, E. (2011). Language and brain: Recasting meaning in the definition of human language. *Semiotica, 2011*(184), 11-11-32. doi:10.1515/semi.2011.020

Stoodley, C. J. and Schmahmann, J. D. (2010).Evidence for topographic organization in the cerebellum of motor control versus cognitive and affective processing. *Cortex*, *46,* 831-844.

Wan, C.Y., Demaine, C., Zipse, L., Norton, A. and Schlaug., G. (2010).From music making to speaking: Engaging the mirror neuron system in autism. Brain *Research Bulletin, 82,* (3-4), **1**61-168.

Leopold, D. A., Rhodes, G. (2010). A comparative view of face perception. *Journal of Comparative Psychology 124*, 233-251.

Hanakawa, T., Immisch, I., Toma, K., Dimyan, M., Van Gelderen, P., & Hallett M. (2003). Functional properties of brain areas associated with motor execution and imagery. *Journal of Neurophysiology, 89*, 989-1002.

Steinberg, D. (2002). Scientific neurology and the history of the clinical examination of selected motor cranial nerves. *Seminars in Neurology. 22,* 349-356.

Small S., & Burton M. (2002). Functional magnetic resonance imaging studies of language. *Current Neurology and Neuroscience Report ,* 505-510.

McKay, L., Evans, K., Frackowiak, R., & Corfield, D. (2003). Neural correlates of voluntary breathing in humans. *Journal of Applied Physiology, (EPub Ahead of Print).*

Kimura, D., & Watson, N. (1989). The relation between oral movement control and speech. *Brain and Language,* *37,* 565-590.

Kent, R. (1976). Anatomical and neuromuscular maturation of the speech mechanism. *Journal of Speech and Hearing Research, 19,* 421-447.

**Evaluation Methods and Deadlines**

Evaluation of students will be based on students assimilation of material and its application to neurological problem solving.

**Final Grade:** The final grade will be based on the average of the section test scores and the literature review score, mitigated by the practical examination Pass/Fail score. Each test score and the literature review score will count equally in the final grade. Letter grades will be assigned as follows:

90-100% = A 60-69% = D

80 - 89% = B (Below 60 = Failure)

 70 - 79% = C

**Section Examinations:** The course is divided into four sections: General Neurology and Gross Neuroanatomy; Microanatomy and Developmental Anatomy; Afferent Systems; Efferent Systems. Section examinations are presented online via the BBLearn shell at opening/closing dates announced in class. Tests submitted after the closing date can earn grades no higher than 80%.

**Practical Examinations:** Students will perform a cranial nerve screening and describe its implications for motor speech evaluation. This is a competency evaluation, and will receive a "Pass" or "Fail" grade. Students must "Pass" this examination to receive a final grade higher than "C". To earn a passing grade, cranial nerve screenings must be completed by 5:00 p.m. on the last day of the term.

**Current Literature Review:** Students will read current literature pertinent to neurological foundations and understand them to the extent that they are equipped to ask questions about each article topic. The question must relate to the content of the article and not pertain to a definition that a student could easily look up.

Acceptable questions will count 20 points each for a total literature review score based on 100 points. Unacceptable questions will not count, nor will questions submitted in the improper order or format, or without current APA citation.

Students MUST submit their article review questions through the BBLearn Journal Board by the posted deadline for each article.

The literature review score will be equivalent to one section test in computing the final course grade.

**STUDENT EVALUATION PROCESS:**

**Section Examinations:** There will be a section test at the end of each section.

**Practical Examinations:** Students may take their practical examinations any time after the in-class demonstration, contained in the lectures on the cranial nerves. Out TA will proctor the practical examinations. Graduate student volunteers, as available, may also be recruited to observe cranial nerve screenings, and their schedules will be posted on Dr. Culbertson’s office door if possible.

**Current Literature Review:**

This assignment is Pass/Fail. Journal board posts will either receive full credit (20 points each) or no credit.

Read the selected items on the course reading list printed in this document. For each article, each student submits, typed, one pertinent question concerning the experimental design or the findings or other content matters. The review question submission must have the article’s FULL CITATION, written in current A.P.A. style, at the top of the page. **Submissions not including citations in current APA style are not acceptable.**

Review questions MUST be submitted in the order they appear in this syllabus, one at a time. Review questions must be submitted directly to BBLearn Journal Board Attachments are acceptable.

**COURSE POLICIES**

**Students must adhere to the Northern Arizona University course policy statements. For the full policy visit:**

<http://nau.edu/OCLDAA/_Forms/UCC/SyllabusPolicyStmts2-2014/>)

**CSD 405 Skills Outcomes re: ASHA Standard IV**

**See: http://www.asha.org/Certification/2014-Speech-Language-Pathology-Certification-Standards/**

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|  |  |  A |  **B** |  **C** |  **D** |  **E** |  **F** |  **G** |  **H** |
| **Learner Outcomes** | **Assessment Method** | Principles of Sciences | **Knowledge of basic human processes** | **Knowledge of Nature of speech, language, hearing and comm. disorders** | **Prevention and assessment and intervention** | **Ethical Conduct** | **Research Principles** | **Professional Issues** | **Professional Credentials** |
| Students will respond to section test items with 70% or greater accuracy. | Section Test |  |  |  |  |  |  |  |  |
| Students will perform a cranial nerve screening on fellow classmates. | Practical Test |  | X | X | X |  |  |  |  |
| Students will apply screening responses of their fellow classmates to communication evaluation by responding accurately to randomly posed questions presented by the observer. | Practical Test |  | X | X | X |  |   |  |   |
| Students will formulate written questions which apply articles in the supplemental reading list to the study of human nervous system functions in communication. | Written Assignment |   | X | X |  |  | X |  |   |

**SCHEDULE OF LECTURE AND STUDY TOPICS**

1. Principles and Applications of Neuroscience to Speech-Language Pathology and Audiology.
	1. Modalities of Communication: Auditory-Vocal, Visual-Motor, Graphic, Somesthetic.
	2. Afferent Modalities
	3. Efferent Modalities
2. General Organization of the Human Nervous System.
	1. Central Nervous System
		1. Brain
		2. Spinal Cord
	2. Peripheral Nervous System
		1. Cranial Nerves and Spinal Nerves
		2. Autonomic Nervous System
			1. Parasympathetic Division
			2. Sympathetic Division
	3. Differences and Similarities
3. Gross Anatomy of Nervous System Structures Related to Communication
	1. The Central Nervous System
		1. The Brain
			1. Telencephalon
				1. Cerebral Hemispheres
				2. Cerebral Cortex

General Structure

Lobes of the Cerebral Cortex

* + - * 1. Subcortical Structures
				2. Cerebral Dominance
				3. Inter- and Intra-Hemispheric Communication
			1. Diencephalon
				1. Thalamus
				2. Hypothalamus
			2. Brainstem
				1. Midbrain
				2. Pons
				3. Medulla Oblongata
			3. Cerebellum
		1. The Spinal Cord
			1. Cross Sections
			2. Ascending and Descending Tracts
		2. Arterial Supply and Venous Drainage of Central Nervous System Structures Essential to Communication.
			1. Arterial Supply
				1. Carotid Supply
				2. Vertebral Supply
				3. Circle of Willis
			2. Venous Drainage
				1. Sinuses
				2. Veins
		3. Cerebrospinal Fluid
		4. Meninges
	1. The Peripheral Nervous System
		1. Cranial Nerves and Motor Speech functions
		2. Cranial Nerve Screening (Demonstration)

*(\* PRACTICAL EXAMINATIONS MAY BEGIN AT THIS POINT.)*

* + 1. Spinal Nerves
			1. Respiratory Function
			2. Extremity Function
		2. The Autonomic Nervous System

**TEST 1: GENERAL NEUROLOGY AND NEUROANATOMY**

1. Microanatomy and Development of the Human Nervous System
	1. Neural Tissue
		1. Characteristics of Neural Tissue
		2. Action Potential
	2. General Anatomy of the Neuron
		1. Cell Body
		2. Axon
		3. Dendrite
	3. Types of Neurons
		1. Unipolar
		2. Bipolar
		3. Multipolar
	4. Embryology of the Nervous System
		1. Neural Tube
		2. Neural Tube Vesicles
			1. Prosencephalon
			2. Mesencephalon
			3. Rhombencephalon
		3. Derivative Structures of the Neural Tube Vesicles

**TEST 2: MICROANATOMY AND DEVELOPMENT OF THE HUMAN NERVOUS SYSTEM**

1. AFFERENT SYSTEMS for COMMUNICATION
	1. The Somatosensory System as a Communicative Modality
		1. The Role of Somesthesis in Communication.
			1. Gross Touch and Fine Touch
			2. Receptors
		2. Conscious and Unconscious Proprioception
		3. Somatosensory Anatomy
			1. Three-Neuron Organization
			2. Posterior (Dorsal) Column Medial Lemniscal System
			3. Spinothalamic Tracts
			4. Trigeminothalamic Tracts
	2. The Visual System as a Communicative Modality
		1. The Role of Vision in Communication
			1. Visual Reception
			2. Visual Perception
			3. Reception, Perception and Interpretation of Graphic and Gestural Language
		2. Anatomy and Physiology of the Visual System
			1. The Peripheral Visual System and Its role in the Visual Motor Modality
				1. Eyeball
				2. Extraocular Muscles
				3. Retina
				4. The Optic Nerve (Tract)
				5. Refraction
				6. Accommodation
				7. Light Reflex
				8. Convergence
			2. The Central Visual Mechanism and Interpretation of Gestural and Graphic Language.
				1. Visual Field
				2. Visual Pathways
				3. Visual Cortex
	3. The Auditory and Vestibular Systems
		1. The Auditory System and Reception of Spoken Language
		2. The Peripheral Auditory System
			1. The Cochlea
			2. The Auditory Nerve
		3. The Central Auditory System
			1. Auditory Pathways
			2. Auditory Cortex
			3. Reception, Perception and Interpretation of Spoken Language
		4. The Vestibular System
			1. The Peripheral Vestibular System
				1. Semicircular Canals
				2. Vestibular Sacs
				3. Vestibular Nerve
			2. The Projections of the Vestibular System
			3. The Physiology of Equilibrium

**TEST 3: AFFERENT SYSTEMS FOR COMMUNICATION**

EFFERENT SYSTEMS for COMMUNICATION

* 1. The Motor System for Communication: Darley, Aaronson and Browns Hierarchy of Motor Function
	2. Major Voluntary Motor Tracts.
		1. Corticospinal Tracts: Anterior and Lateral
		2. Corticobulbar tracts: #1 and #2
	3. Extrapyramidal Tracts
	4. Motor Neuron Function in Speech
		1. Alpha Motor Neurons
		2. Gamma Motor System
		3. Myoneural Junction
		4. Muscle Spindles
		5. Spinal Reflexes

**TEST 4: EFFERENT SYSTEMS FOR COMMUNICATION**