

THE AUDITORY PERIPHERY
SLHS 504 (SLHS 519D in 2008) Fall 2008

Time: T/Th 1:30-2:45pm
Room: HEAV G35
Credits: 3

Instructor: Dr. Michael Heinz
Office: G34C Heavilon Hall
Phone: 496-6627
Email: mheinz@purdue.edu
Office hours: by appointment (Mondays 2-3pm preferred)

Required text: From Sound to Synapse, by Geisler

Supplemental text: An Introduction to the Physiology of Hearing, by Pickles (Chpts. 1,2,3,5,10)

Grading policy (plus/minus grading will be used):

Midterm exams (2)	40%
Paper Abstracts	15%
Paper presentation and summary	15%
Participation	10%
Final paper	20%

Blackboard: A course webpage will include copies of the discussion papers as well as posted grades.

Paper presentations, abstracts, and summary paper: Each student will be responsible for presenting one paper during the semester (see syllabus – **BOLD** articles to be presented by students).

Students should schedule at least one meeting with me prior to your class discussion to review your article and presentation. The presentation will be roughly 20 minutes followed by 10 minutes of discussion facilitated by the student. The remainder of the class period will be used for supplemental lecture material or discussion by the instructor. In addition to the presentation, the student will submit a 2-page (single spaced) summary of the paper within one week of the discussion. This summary paper should be written at a level to be understood by your fellow students and will be handed out to the class for their use.

In addition to the student-led discussions, other papers will be discussed in class and those students not presenting will write a brief abstract of specified length (500-200 words, depending on the week), which will be due at the beginning of the discussion (see syllabus – abstracts due for UNDERLINED articles – 14 total, you can skip any 2 in addition to the paper you present, i.e. 11 total to be submitted). These abstracts are to be written at a level appropriate for a motivated patient who might be interested in the basics of this paper and the possible significance for hearing and hearing loss. Writing at this level (i.e., being able to communicate scientific results with patients) will be a focus of this course and is a very important skill for both the clinician and researcher.

The remaining papers (no **BOLD**, no UNDERLINE) are provided as supplemental readings, which will not be covered on the exams except for any material discussed in lecture.

Final paper: A final paper roughly 10 pages in length (double spaced) will be due during exam week. *This paper will provide a summary of how the ear works, what goes wrong with the ear in various forms of hearing loss, and a discussion of the physiological issues involved in trying to treat hearing loss.* The paper should be written at a level appropriate for a motivated patient who might be

interested in reading a brief overview of the physiology underlying their hearing loss. The paper will be graded based on two criteria: 1) scientific accuracy (appropriate references should be provided for the extra motivated patient who would be interested in looking further into the details of what you discuss), and 2) accessibility for the patient.

Class guidelines: You are responsible for all material covered in class and in the readings. Do the readings before class. Many people in the past have found this to be a challenging course. Your success will be related to how much you actively participate in mastering the material, both in class and on your own. Please ask questions in class and during office hours. If you don't understand what is going on, your classmates probably don't either. The two mid-term exams will be take-home, integrative exams. They will be handed out in class on a Tuesday and will be due by 5pm on Friday (paper copy to me or in my mailbox, PLUS an email with attachment).

Students with Disabilities

Students with disabilities must be registered with Adaptive Programs in the Office of the Dean of Students before classroom accommodations can be provided. If you have a disability that requires academic adjustments, please discuss your needs with me as soon as possible.

Course Flexibility in the Case of Unexpected Emergencies

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Here are ways to get information about changes in this course. Blackboard Vista web page, my email address: mheinz@purdue.edu, and my office phone: 496-6627. Additional suggestions for best practices in the case of a campus emergency are available at: <http://www.itap.purdue.edu/tlt/faculty/>.

Class Schedule (tentative): Note: Readings listed on the syllabus for each week correspond to the material discussed that week, and thus should be read prior to each class. Chapters listed are from the Geisler text (Chpts. 1,2,3,5,10 in Pickles provide supplemental reading).

Week	Date	Topic	Reading
1	8/26	Introduction, review	Ch. 1 and 2
	8/28	Review: acoustics, Fourier anal., resonance, impedance	Apps. A, B, C.
2	9/2	Outer ear	Ch. 3, <u>Wiener and Ross (1946)</u> (**ABS due 9/4)
	9/4	Middle ear	Ch. 4
3	9/9	No class: BME Acoustics Conference (if interested, poster session 1-2:30 in MJIS atrium)	
	9/11	Middle ear	
4	9/16	Inner ear – mechanical responses	Ch. 5
	9/18	Inner ear – mechanical responses	<u>Rhode (1971)</u>
5	9/23	Stimulation of hair cells	Ch. 6
	9/25	Transduction in hair cells	Ch. 7
6	9/30	Transduction in hair cells	Sellick et al (1983)
	10/2	Hair cell electrophysiology	Ch. 8
7	10/7	Endocochlear potential	<u>Sewell (1984)</u>
		EXAM 1 out 10/7, due Friday 10/10 at 5pm	
	10/9	OHC motility – prestin	<u>Liberman et al (2002)</u>
8	10/14	OCTOBER BREAK - no class	
	10/16	Cochlear amplifier	Ch. 9, Robles and Ruggero (2001, review paper)
9	10/21	Cochlear amplifier	<u>Ruggero et al. (1997)</u>
	10/23	Cochlear amplifier	<u>Moore et al. (1999)</u>
10	10/28	Suppression	Ch. 10 (pp. 139-151), Sachs and Kiang (1968)
	10/30	Suppression	<u>Kiang and Moxon (1974)</u>
11	11/4	Otoacoustic emissions	Ch. 10 (pp. 152-165); <u>Kemp (1978)</u>
	11/6	Otoacoustic emissions	Shera and Guinan (1999); <u>Shaffer et al (2003)</u>
12	11/11	Human Cochlear Tuning	<u>Shera et al (2002)</u>
	11/13	Efferent feedback	Ch. 15, Guinan (2006, review paper)

13	11/18	Efferent feedback	Lieberman et al (1996); Maison, Liberman (2000)
	11/20	Efferent feedback	Zeng et al (2000)
14	11/25	Damage to the ear	Ch. 16, <u>Lieberman and Dodds (1984)</u>
	11/27	THANKSGIVING - no class	
15	12/2	Damage to the ear	<u>Schmiedt et al (2002)</u>
		EXAM 2 out 12/2, due Friday 12/5 at 5pm	
	12/4	Damage to the ear	<u>Nadol (1980)</u>
16	12/9	Treatments for damaged ears	Ch. 17
	12/11	Treatments for damaged ears	Birmingham-McDonogh and Rubel (2003)
FINAL	12/17	Final paper due Wed. by 5pm (same submission policy as for exams, see above)	

1. Birmingham-McDonogh, O. and E. W. Rubel (2003). "Hair cell regeneration: winging our way towards a sound future." *Curr Opin Neurobiol* 13(1): 119-126.
2. Guinan J. J., Jr. (2006). "Olivocochlear efferents: anatomy, physiology, function, and the measurement of efferent effects in humans," *Ear Hear.* 27, 589-607.
3. **Kemp, D. T. (1978). "Stimulated acoustic emissions from within the human auditory system," *J. Acoust. Soc. Am.* 64(5), 1386-1391.**
4. Kiang, N.Y.S, and Moxon, E.C. (1974). "Tails of tuning curves of auditory-nerve fibers," *J. Acoust. Soc. Amer.* 55: 620-630.
5. Liberman, M.C., and Dodds, L.W. (1984). "Single-neuron labeling and chronic cochlear pathology. III. Stereocilia damage and alterations of threshold tuning curves," *Hear. Res.* 16, 55-74.
6. Liberman M., Puria S., and Guinan J. (1996). "The ipsilaterally evoked olivocochlear reflex causes rapid adaptation of the 2f1-f2 distortion product otoacoustic emission," *J. Acoust. Soc. Am.* 99, 3572-3584.
7. **Liberman, M. C., J. Gao, D. Z. He, X. Wu, S. Jia, and J. Zuo. (2002). "Prestin is Required for Electromotility of the Outer Hair Cell and for the Cochlear Amplifier." *Nature* 28, 300-304.**
8. **Maison, S.F. and Liberman, M.C. (2000). "Predicting vulnerability to acoustic injury with a noninvasive assay of olivocochlear reflex strength," *J. Neurosci.* 20(12):4701-4707.**
9. Moore, B.C, D.A. Vickers, C.J. Plack and A.J. Oxenham (1999) Inter-relationship between different psychoacoustic measures assumed to be related to the cochlear active mechanism. *J. Acoust. Soc. Amer.* 106(5): 2761-2778.
10. **Nadol, J.B., Jr. (1980). "The aging peripheral hearing mechanism," in *AGING Communication Processes and Disorders*, Ed. by D.S. Beasley and G.A. Davis, Grune & Stratton, Inc., pp. 63-85.**
11. Rhode, W. S. (1971). "Observations of the vibration of the basilar membrane in squirrel monkeys using the Mossbauer technique," *J. Acoust. Soc. Am.* 49, 1218-1231.
12. Robles L. and Ruggero M. A. (2001)."Mechanics of the mammalian cochlea," *Physiol Rev* 81, 1305-1352.
13. **Ruggero, M.A., Rich, N.C., Recio, A. Narayan, S.S., and Robles, L. (1997). "Basilar membrane responses to tones at the base of the chinchilla cochlea," *J. Acoust. Soc. Am.* 101, 2151-2163.**
14. Sachs M. B., and Kiang N. Y. (1968). "Two-tone inhibition in auditory-nerve fibers," *J. Acoust. Soc. Am.* 43, 1120-1128.
15. **Schmiedt, R.A., Lang, H., Okamura, H.O., and Schulte, B.A. (2002). "Effects of furosemide applied chronically to the round window: a model of metabolic presbycusis. *J. Neurosci.* 22, 9643-9650.**
16. Sellick, P.M., Patuzzi, R. and Johnstone, B.M. (1983). "Comparison between the tuning properties of inner hair cells and basilar membrane motion," *Hear Res.* 10, 93-100.
17. **Sewell, W.F. (1984). "The effects of furosemide on the endocochlear potential and auditory nerve fiber tuning curves in cats," *Hear. Res.* 14, 305-314.**
18. **Shaffer, L. A., Withnell, R. H., Dhar, S., Lilly, D. J., Goodman, S. S., and Harmon, K. M. (2003). "Sources and mechanisms of DPOAE generation: Implications for the prediction of auditory sensitivity," *Ear and Hearing* 24(5), 367-379.**
19. Shera C. A., and Guinan J. J., Jr. (1999). "Evoked otoacoustic emissions arise by two fundamentally different mechanisms: a taxonomy for mammalian OAEs," *J. Acoust. Soc. Am.* 105, 782-798.
20. **Shera, C. A., J. J. Guinan, Jr., et al. (2002). "Revised estimates of human cochlear tuning from otoacoustic and behavioral measurements." *Proc Natl Acad Sci*, 99(5): 3318-3323.**
21. Wiener, F.M. and Ross, D.A. (1946). "The pressure distribution in the auditory canal in a progressive sound field," *J. Acoust. Soc. Am.* 18, 401-408.
22. Zeng F. G., Martino K. M., Linthicum F. H., and Soli S. D. (2000). "Auditory perception in vestibular neurectomy subjects," *Hear. Res.* 142, 102-112.

Department of Speech, Language, and Hearing Sciences
Course Syllabus - ASHA Standards

Course Number: SLHS 504 (519D in 2008)

Course Title: The Auditory Periphery

Instructor: Michael Heinz

Semester: Fall 2008

American Speech-Language Hearing Association (ASHA) Certification Standards Addressed in this Course

IV-B, B4
IV-B, B8
IV-B, B10

Behaviorally Defined Objectives Related to the Standards and the Target Knowledge/Skills to be Acquired Upon Course Completion

IV-B B4: The student will be able to identify and describe the structure and function of the auditory system up to the cochlea. They will understand the effects of pathology on the functioning of the auditory system up through the cochlea.

IV-B B8: The student will demonstrate knowledge of normal aspects of auditory physiology and behavior over the life span.

IV-B B10: The student will demonstrate knowledge of the effects of chemical agents on the auditory system.

Evidence for Evaluation of Achievement of Target Knowledge/Skills Competencies

Examinations, discussions of papers, and written assignments.

Opportunities for Remediation

If the level of knowledge/skill expected upon the completion of this class are not achieved in the first assessment, the following remediation option is available:

Area must be covered in the gateway exam.