Anatomy and Physiology of the Auditory and Vestibular Systems (SLHS-562A)
(Tues. & Thurs. 2:30 - 3:45) Speech & Hearing Sciences Building, Rm 203

Description of Course
Focuses on anatomy, physiology, and neurophysiology of the auditory and vestibular systems and current research in these areas.

Instructor and Contact Information
Instructor: Frank E. Musiek, SLHS Rm 526, (520) 621-3726, fmusiek@email.arizona.edu
Office Hours- TBA
Assistant: Barrett St. George – graduate research assistant, NeuroAudiology Lab- SLHS Rm 525, stgeorge@email.arizona.edu

Course Format and Teaching Methods
This course is taught primarily as a lecture. There will be some in-class discussion to facilitate understanding of course content.

D2L will have Anatomy and Physiology slides
There are a number of WEB SITES for anatomy of the auditory system – visit them!

Reference lists in Musiek & Baran (textbook) for additional reading and investigation.

Course Objectives and Expected Learning Outcomes
1. Students will be able to outline key structures of the peripheral and central auditory systems in ascending fashion.
2. Students will be able to discuss the physiological processing of intensity, frequency and time in both the peripheral and central auditory systems.
3. Students will be able to identify from models and actual specimens key structures of the peripheral and central auditory systems.
4. Students will be able to discuss the influence of pathology on both peripheral and central auditory mechanisms.

Absence and Class Participation Policy
The UA’s policy concerning Class Attendance, Participation, and Administrative Drops is available at http://catalog.arizona.edu/2015-16/policies/classatten.htm

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable: http://policy.arizona.edu/human-resources/religious-accommodation-policy.

Absences preapproved by the UA Dean of Students (or dean’s designee) will be honored. See http://uhap.web.arizona.edu/policy/appointed-personnel/7.04.02

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Students who miss class due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences.

Required Texts or Readings
The primary text will be “The Auditory System: Its Anatomy, Physiology and Clinical Correlates” (Musiek &
Baran). You also need to have ready access to:

- Gelfand, Hearing: Physiological and Psychological Acoustics (any edition)
- Musiek, Baran, Shinn, Jones: Disorders of the Auditory System

The primary textbook (Musiek & Baran) is available to purchase through the UofA bookstore: http://shop.uabookstore.arizona.edu/main/CourseMaterials.aspx.

Assignments and Examinations: Schedule/Due Dates

There will be 12 quizzes (approximately 1 quiz per week) worth 5 pts each. There will be a final Exam on 12/13/16 from 3:30-5:30PM worth 100 pts. There will also be an oral presentation that is worth 25 pts (this presentation date will be assigned to you at the beginning of the semester). Accordingly, the total points in this course is 185 points.

Grading Scale and Policies

A final grade of 90 - 100% (167 points or more) is an “A”. A final grade of 80 - 89% (148 – 166) is a “B”, and so forth. There will be no rounding or curving of grades.

The student’s final grade will be calculated simply by dividing the total earned points by the total possible points that can be obtained in the course. Under most circumstances, late work will not be accepted, unless previously approved by instructor.

Extra credit is possible – needs to be approved by instructor.

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/2015-16/policies/grade.htm#I and http://catalog.arizona.edu/2015-16/policies/grade.htm#W, respectively.

Scheduled Topics/Activities

08/23-25  Overview of the course and the need for understanding structure and function of the auditory system for audiology.

Cell biology: a snapshot

Overview of anatomy & physiology of the auditory system. -- anatomical planes; Outdoor ear: funneling? -- Localization, head shadow effect

-- Freq. bias, & resonance of outer ear

Middle ear: anatomy, vibration patterns of TM, area ratio, lever ratio -- Transformer action – Bone conduction: modes of B/C-- Pathophysiology of the conductive mechanism-- Acoustic reflex

Readings: Musiek & Baran, ch. 1, pp. 1-17, ch. 3

08/30  The cochlea: anatomy (gross and fine structure), characteristics of the traveling wave, and cochlear mechanics, cochlear electrophysiology, frequency and intensity coding, outer hair cells, biological amplifier, OAEs, non linearity, recruitment. Microscope Slide review. No class 9/1 (Labor Day)

Readings: Musiek & Baran, ch. 4, 5, & 6; Gelfand, ch. 4, Moller, pp. 75-76, 96-99.

09/6-8  Cochlear function con’t . Microscope slide review

Readings: same as previous week

09/13-15  Cochlear electrophysiology and pathophysiology, ECP, CM, SP, NIHL, hydrops, recruitment, tinnitus.

Readings: same; Moller, pp 396-398,409-418, 422-428, 461-472

09/20-22  Finish cochlea, start Auditory Nerve; The nerve cell anatomy, IAM, tonotopic arrangement, frequency coding, (tuning curves) intensity coding, spontaneous activity, action potentials, Volley theory, pathology

Readings: Musiek & Baran, ch. 7; Gelfand, ch. 5; Moller, pp. 155-157, 171-173.
09/27-29 Auditory nerve con’t & animations

10/4-6 Brainstem pathway; anatomy; acoustic/startle reflexes, tonotopic aspects, frequency/intensity coding, ABR, binaural processes, vascular anatomy
Readings: Musiek & Baran, ch. 1; pp 17-24 (CANS)

10/11-13 Brainstem con’t, Vascular anatomy

10/18-20 Auditory cortex and sub cortex, anatomy, tonotopic aspects, coding intensity, EPs.
Readings: Musiek, Baran, ch. 12

10/25-27 * Brain dissection (tentative) or 3-D brain print models

11/1-3 Interhemispheric and efferent function. Anatomy, transcallosal activity, neurological aspects,
Readings: Musiek & Baran, ch. 13.

11/8-10 Pathoanatomy, pathophysiology of the CANS (Readings to be announced) Vascular anatomy

11/15-17 Efferent system
Readings: ch. 15.

11/22 OCB, neurotransmitters No class 11/24 (Thanksgiving Recess)

11/29 & 12/1 Neuroradiology (optional), or selected topics, catch up

12/6 Catch up and Review. No class 12/8 (Reading Day)

12/13 FINAL EXAM (3:30-5:30pm) -- room to be announced.

**Topics for Oral Presentation: the “classics”**

1. Neff, Butler & Diamond – Discrimination findings related to Ablations of Auditory Cortex in Cat.
2. Bekesy's experiments leading up to the Nobel Prize.
3. Penfield's experiments on auditory cortex stimulation during neurosurgery.
4. Dublin's work on the pathology of kernicterus (hyperbilirubinemia).
5. Galmabos's experiments on the OCB.
8. Carharts tone decay test and related studies on adaptation.
9. Moller's recordings of the ABR waves during neurosurgery.
10. Schuknecht's cochleogram and damage from high intensity noise exposure.
11. The Heffners' early work on primate brain ablations and hearing.
12. Dewson's experiments on OCB and noise.
13. Woolsey's research on auditory cortex.
14. Catherine Smith, vascular anatomy studies
15. Zwislocki's studies on “fundamentals” of the cochlea. Or central masking
16. Tonndorf's studies on cochlear function or bone conductio
17. W. House, electrical stimulation of the auditory nerve & early cochlear implants.
18. Pandya's work on inter-hemispheric connections.
19. J. Vernon & others, mechanisms of tinnitus.
20. Nelson Kiang: studies of the physiology of the auditory nerve

This presentation will require a 12 minute lecture on the topic selected. At the time of the presentation you will need to hand in a concise 2 page summary and key references of the main points of your presentation. You should include at least 1 illustration or figure. Your grade will be solely dependent on your presentation unless
the summary is very poorly done or not turned in—then points will be subtracted from your presentation.

**Principles to Guide You in Reading Neurobiology of the Auditory System**

- The more rostral you proceed up the auditory system the more humans and animals are dissimilar.
- There are many errors in publication on anatomy and physiology (A & P) of the auditory system. Be careful of publications that are not peer reviewed and internet information that is not med line. If you are unsure ask the instructor.
- There has been a virtual explosion of information on A & P of the auditory system in the past decade. This is great but much is not highly relevant to audiology, let's work on mostly information that is pertinent.
- Auditory neurobiology, functional anatomy, biology, neuroscience, physiology, neurophysiology, physiological acoustics, for purposes of this course are all synonyms for structure and function.
- Anatomy physiology and psychoacoustics are tightly linked; one tells us about the other. Both in normal and disordered states.
- Knowledge about A & P of the auditory system is knowledge about hearing.
- It has been well shown that individuals well-grounded in A & P make the best clinical audiologists (especially in diagnostics).
- Diagnostic audiology has and will continue to be anatomically based, i.e., conductive, sensorineural, cochlear, retrocochlear, peripheral, central, etc.
- The auditory system works sequentially and in parallel. This facilitates quick processing.
- The auditory system is highly temporal, speed is critical. In the auditory system it is the "Quick and the dead" – it operates quickly or it doesn't operate appropriately.
- The peripheral auditory system is practically mature at birth but the central auditory system matures in the teenage years.

**Classroom Behavior Policy**

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

**Threatening Behavior Policy**

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See [http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students](http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students).

**Accessibility and Accommodations**

Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621-3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit [http://drc.arizona.edu](http://drc.arizona.edu).

If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

**Code of Academic Integrity**

Students are encouraged to share intellectual views and discuss freely the principles and applications of course
materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See [http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity](http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity).

The University Libraries have some excellent tips for avoiding plagiarism, available at [http://www.library.arizona.edu/help/tutorials/plagiarism/index.html](http://www.library.arizona.edu/help/tutorials/plagiarism/index.html).

*Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor’s express written consent.* Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

**UA Nondiscrimination and Anti-harassment Policy**

The University is committed to creating and maintaining an environment free of discrimination; see [http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy](http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy).

**Additional Resources for Students**

UA Academic policies and procedures are available at [http://catalog.arizona.edu/2015-16/policies/aaindex.html](http://catalog.arizona.edu/2015-16/policies/aaindex.html).

Student Assistance and Advocacy information is available at [http://deanofstudents.arizona.edu/student-assistance/students/student-assistance](http://deanofstudents.arizona.edu/student-assistance/students/student-assistance).

**Subject to Change Statement**

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.