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9.01 Introduction to Neuroscience
Fall 2007

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9.01 Recitation (R02)

RECITATION #5: Tuesday, October 23rd

Review of Lecture: 11, 12

Reading: Chapter 10 and 11 of *Neuroscience: Exploring the Brain* (3rd edition)

Outline of Recitation:

- I. Reminders:
 - a. Problem Set #2 **due this FRIDAY**
- II. Review of Material:
 - a. **Finish Vision:**
 - i. Color perception
 - ii. Pathway of visual perception
 - b. **Auditory System**
 - i. Pathway of auditory perception
- III. Practice Exam Questions

VISION:

Color perception: (p296, 304)

Young-Helmholtz trichromacy theory

- The theory that the brain assigns colors based on a comparison of the readout of the three types of cone photoreceptors.

Color after-effect: (example: pink/green dot illusion)

- Adaptation → sustained stimulus (pink dots), get transient response
- Perception to change (see green dot)

Color-opponent ganglion cells:

- Center-surround receptive fields
- Similar to ON/OFF but using colors (R/G, B/Y)

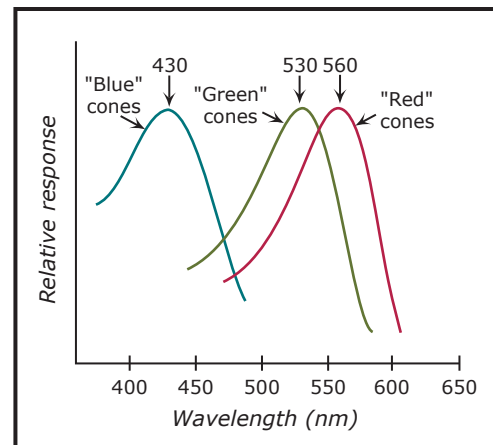


Figure by MIT OpenCourseWare. After figure 9.20 in: Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain*. 2nd ed. Baltimore, Md.: Lippincott Williams & Wilkins, 2001. ISBN: 0683305964.

[above] example of a tuning curve

Pathway for “conscious” visual perception: (Chapter 10)

Retinofugal projection:

----->
Via the

----->

----->

OR

Cortical cell receptive fields:

- elongated ON and OFF sub regions
- orientation and direction selectivity
 - preferred orientation
 - null orientation
- simple cells: segregated ON and OFF regions
- complex cells: ON and OFF responses through out (more complex)

AUDITORY SYSTEM:

Basic auditory pathway:

(1) Sound wave move the _____

- Range:
- Pure tones:
- Harmonic stack:

(2) _____ moves the ossicles

- _____ → _____ → _____

(3) Ossicles move the membrane at the _____

(4) Motion at the _____ moves the fluid in the cochlea

- Pressure greater because
 - a.
 - b.

(5) Movement of fluid in cochlea causes traveling wave in _____

- Place code for frequency:
 - Sound waves of different frequencies peak at different locations
 - Frequency is an indicator of producer

(6) Movement of _____ causes depolarization of _____

- Figure 11.13

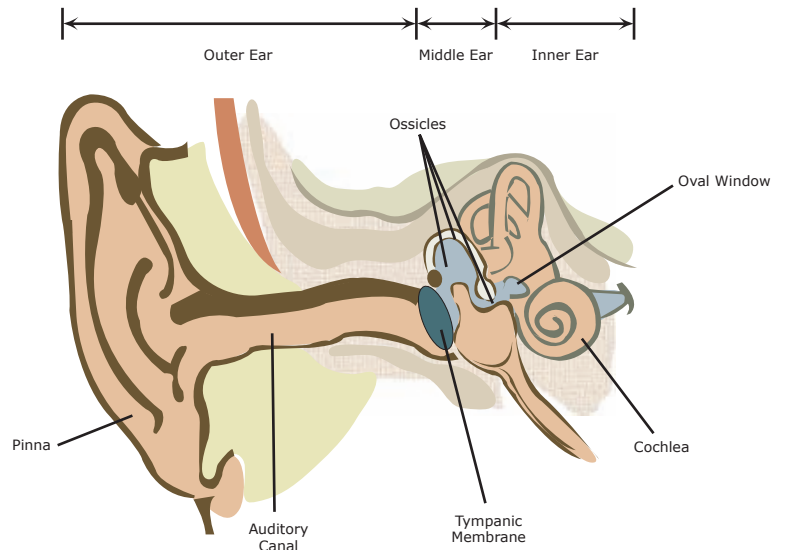


Figure by MIT OpenCourseWare. After figure 11.3 in: Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain*. 2nd ed. Baltimore, Md.: Lippincott Williams & Wilkins, 2001. ISBN: 0683305964.

- Figure 11.15

(7) _____ synapse on _____ whose axons make up the auditory nerve.

- Figure 11.16

- **Cochlear amplifier:**

Outer hair cells act like tiny motors that amplify the movement of the basilar membrane during low-intensity stimuli

Figure 11.17

(8) **Auditory nerve projects to....**

Ventral cochlear nucleus and Superior olive → Inferior colliculus → MGN → Auditory Cortex

- **Tonotopy:** systematic organization of characteristic frequency within an auditory structure
 - Tonotopic maps exist on the basilar membrane, within each relay nuclei, MGN, and auditory cortex
- **Mechanisms of sound location:**
 - Localization on the horizontal plane: duplex theory of sound localization (interaural time delay and interaural intensity difference)
 - Localization on the vertical plane: based on reflections from the pinna

PRACTICE EXAM QUESTIONS:

30. All the following are key functions of the external ear EXCEPT:

- a) filter out sound frequencies below 20 cycles/sec
- b) modify sound based on vertical direction
- c) amplify sound hitting the ear drum
- d) focus sensitivity to the front

31. Which of the following factors help amplify incoming sound signals within the ear?

- a) The large size of the pinna relative to the smaller tympanic membrane.
- b) The large size of the round window relative to the size of the tympanic membrane
- c) The ossicles within the middle ear.
- d) A, B and C
- e) A and C

32. You're trying to study for the neuro test when your roommate starts playing some Shakira. In what order do your annoyed ossicles oscillate?

- a) Malleus ? Stapes ? Incus
- b) Malleus ? Incus ? Stapes
- c) Incus ? Cochlea ? Malleus
- d) Stapes ? Incus ? Cochlea

33. The base of the basilar membrane is _____ and therefore responds vigorously to _____ sound frequencies.

- a) wide and floppy / high
- b) wide and floppy / low
- c) narrow and stiff / high
- d) narrow and stiff / low
- e) canine / high barking

34. The Organ of Corti:

- a) is found within the scala vestibuli.
- b) sits on Reissner's membrane
- c) converts changes in air pressure into changes in fluid pressure
- d) depends on the rods of Corti for physical support and rigidity
- e) was recently installed in the Cathedral of Corti

35. All of the following statements about hair cells are true EXCEPT:

- a) there are three times as many outer hair cells as inner hair cells

b) 90% of the afferents reaching the spiral ganglion are from outer hair cells

- c) both inner and outer hair cells have stereocilia
- d) both inner and outer hair cells are found in the Organ of Corti
- e) all of the above are TRUE

36. After an all day competition at the Ginsu National Knife Fighting Competition, your roommate complains he cannot hear out of one ear. Because you are a brilliant Neuro 1 student, you offer to diagnose his problem. You determine that his ears are fine, so there must be unilateral damage to his:

- a) auditory cortex
- b) cochlear nucleus
- c) inferior colliculus
- d) MGN
- e) superior olive

37. Coincidence detecting neurons in which auditory structure are responsible for localizing sound in the horizontal plane?

- a) auditory cortex
- b) cochlear nucleus
- c) inferior colliculus
- d) MGN
- e) superior olive

38. The endocochlear potential is created by:

- a) high sodium concentration in the endolymph
- b) high potassium concentration in the scala tympani
- c) secretion against ionic concentration gradients at the stria vascularis
- d) the perilymph that bathes the stereocilia of inner hair cells

39. All the following events occur in auditory transduction EXCEPT:

- a) stereocilia bend to open potassium channels
- b) potassium hyperpolarizes the hair cell
- c) via the piezoelectric effect, a voltage change in outer hair cells alters their length
- d) voltage-gated Ca^{++} channels open causing neurotransmitter release

ANSWERS: 30. A 31. E 32. B 33. C 34. D 35. B 36. B 37. E 38. C 39. B