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9.01 Introduction to Neuroscience
Fall 2007

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9.01 Recitation (R02)

RECITATION #6: Tuesday, October 30th

Review of Lecture: 13, 14

Reading: Chapter 8 and 13 of *Neuroscience: Exploring the Brain* (3rd edition)

Outline of Recitation:

- I. Reminders:
 - a. **EXAM II next week MONDAY**: exam will cover up to tomorrow's lecture
 - b. PSET 2 solutions online
 - c. Correction on last handout: base = 16 kHz; apex = 500 Hz
- II. Review of Material:
 - a. **TASTE**
 - b. **OLFACTION**
 - c. **MOTOR**
- III. Practice Exam Questions

TASTE:

On the tongue there are _____. Each of these is made up of one to several hundred _____. Each of these is made up of 50-150 _____.

Taste receptor cells can detect five basic tastes.

Five basic tastes:

	Tastant	Receptor	Receptor Type
Salty			
Sour			
Sweet			
Umami			
Bitter			

Transduction Mechanisms:

Salty

Sour

Sweet, Umami, & Bitter

Distributed neural code:

- 90% of receptor cells respond to _____
- Opposite of _____

Central Taste Pathway:

- Tongue
 → _____
 → _____
 → _____

Population coding:

- responses of a large number of broadly tuned neurons, rather than a small number of precisely tuned neurons, are used to specify the properties of a particular stimulus such as taste

Other things covered in lecture:

- Experiments to test which cells respond to which tastants, etc.

OLFACTION:

- Smell is an important part of taste (Jellybean experiment)

In the nose, the _____ has _____. These are genuine neurons, with axons that fire action potentials.

Transduction mechanism:

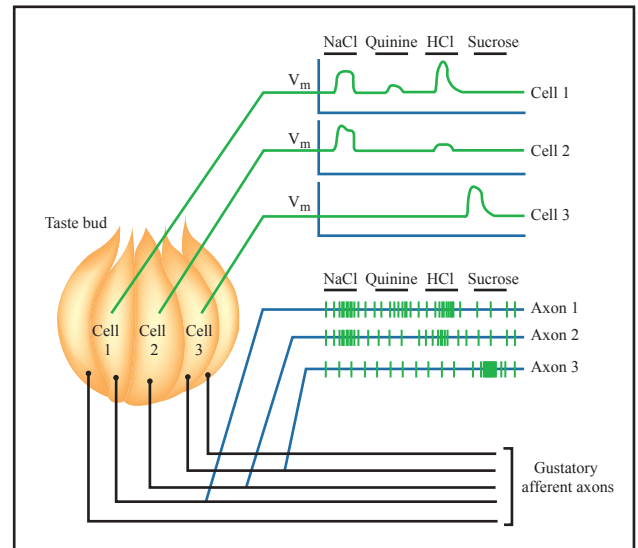


Figure by MIT OpenCourseWare. After Figure 8.3 in Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience: Exploring the Brain*. 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2007.

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We can discriminate thousands of different odorants because we have many different types of odorant receptor cells, each identified by the one particular gene it expresses. Each _____ receives input from only receptor cells expressing a particular protein gene.

Central Olfactory Pathway:

Olfactory receptor cells → Olfactory bulb → _____ → _____ → _____
OR

Olfactory receptor cells → Olfactory bulb → _____
- this is unique because all other sensory systems first pass through thalamus before cortex

SOMATIC MOTOR SYSTEM:

Each skeletal muscle has hundreds of _____ (the cells of skeletal muscles) and each fiber is innervated by a *single axon branch (alpha neuron)*.

Lower Motor Neurons:

Two types: (1) alpha motor neurons (2) gamma motor neurons

(1) Alpha Motor Neurons:

Figure 13.3

Figure 13.6

*one alpha neuron for many muscle fibers...but one muscle fiber does not have many alpha neurons

Alpha neurons directly trigger the generation of force by muscles.

Muscle force controlled two ways:

- (1)
- (2)

Molecular basis for muscle contraction:

Actin:

Myosin:

Contractions occur when actin slide along myosin (crowd surfing).

Summary of steps: (More detailed on p436)

- (1) alpha motor neurons release Ach at neuromuscular junction
- (2) Cascade of events result in release of Ca ions
- (3) Ca²⁺ binds to troponin (at rest, troponin blocks actin binding sites)
- (4) Myosin heads bind to actin and pivot
- (5) Myosin heads disengage at the expense of ATP

Proprioception: informs us about how our body is positioned and moving in space

Monosynaptic myotatic (stretch) reflex:

Example: knee jerking reflex

(2) Gamma Motor Neurons

- alpha motor neurons innervate extrafusal fibers
- gamma motor neurons innervate intrafusal fibers
 - causes poles of muscle spindle to remain “on-air”

Figure 13.19:

“**gamma loop**”: gamma motor neurons → intrafusal muscle fibers → Ia afferent axon → alpha motor neuron → extrafusal muscle fibers

Other proprioceptors: golgi tendon organ; joints

Reciprocal inhibition: the contraction of one set of muscles accompanied by the relaxation of the antagonist muscles

Central pattern generators: circuits that give rise to rhythmic motor activity (walking)

PRACTICE EXAM QUESTIONS:

I couldn't find any practice questions on taste and olfaction; however, you should still learn all the material because it will show up on this year's exam. The following are questions of the motor system.

18. Compared to Slow-twitch muscle fibers, Fast-twitch muscle fibers have

- more mitochondria
- more blood vessels feeding them
- more energy stored as glycogen
- greater capacity to contract for long periods of time
- More than one of the above.

19. Which of the following synapses on an alpha motor neuron

- other alpha motor neurons
- gamma motor neurons
- proprioceptive afferents
- neurons of the basal ganglia

20. The force exerted during a movement depends on all of the following except:

- the number of active motor units
- the firing rate of alpha motor neurons
- the amplitude of the action potentials fired by alpha motor neurons
- the number of agonist muscles co-contracting

21. The flexor-crossed-extensor reflex can be used to get our limbs out of harm's way. The circuitry underlying this reflex:

- includes more than one synapse in the central nervous system

- activates muscles on both sides of the body
- is also part of a central pattern generator
- All of the above

22. You are helping a friend move some heavy textbooks. While you hold a box, your friend starts putting books into it. As the weight increases, the force exerted by your muscles is adjusted and the box is kept steady thanks to the

- clasp-knife reflex
- stretch reflex
- withdrawal reflex
- Duran Duran Reflex (“Evey little thing the reflex does leaves you answered with a question mark.”)

23. Muscle spindles are

- responsible for encoding small changes in muscle length
- responsible for generating force during muscle contraction
- responsible for encoding the amount of tension in tendons
- innervated by gamma motor neurons
- More than one of the above

Answers: 18. C; 19. C; 30. C; 21. D; 22. B; 23. E