

## Chapter 50: Sensory and Motor Mechanisms

As in Chapter 49, there are several topics in this chapter that we will emphasize only lightly. If your teacher stresses human anatomy and physiology, you may be expected to go into more depth. In this Reading Guide, we will ask you to cover only material that might be on an AP Biology exam.

### *Concept 50.1 Sensory receptors transduce stimulus energy and transmit signals to the central nervous system*

1. In the Reading Guide for Chapter 49, you labeled a reflex pathway, including *receptors*. Here is a list of the different types of receptors. Explain each type, and give an example.

**mechanoreceptors**

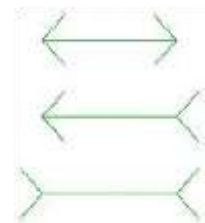
**chemoreceptors**

**electromagnetic receptors**

**thermoreceptors**

**pain receptors**

2. What is *perception*? Explain the difference between what you see and what you *perceive* when you see an optical illusion like this.

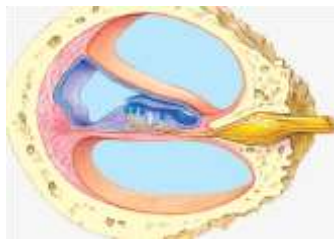
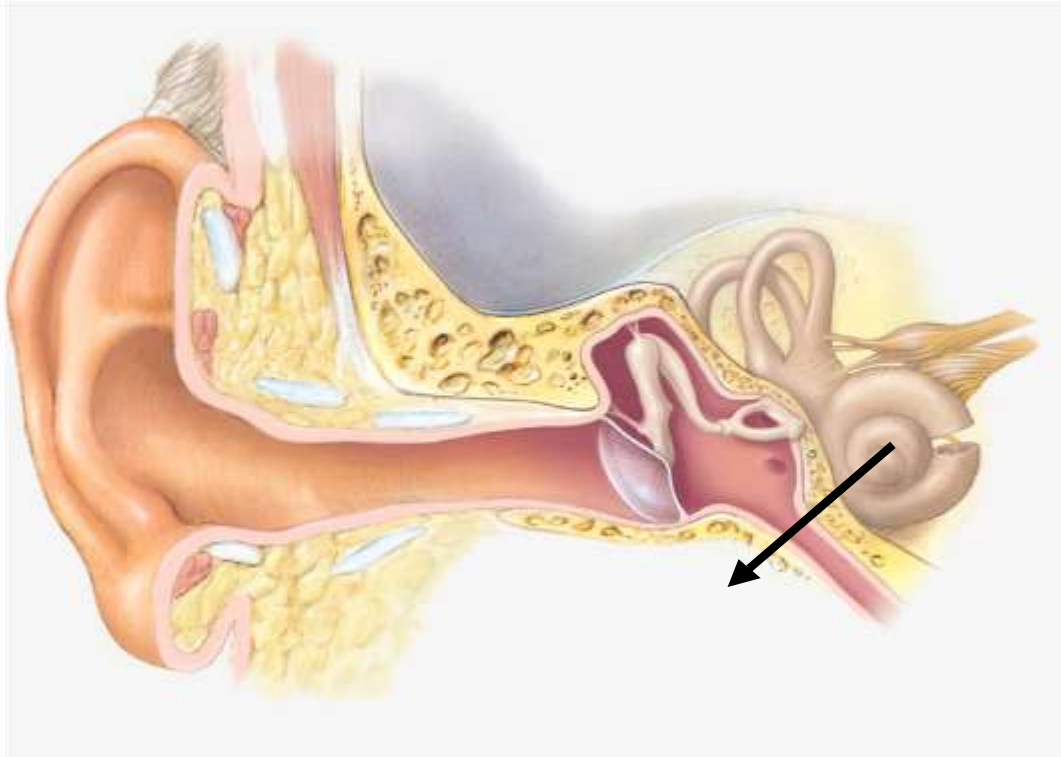


### *Concept 50.2 The mechanoreceptors responsible for hearing and equilibrium detect moving fluid or settling particles*

3. Explain how *statocysts* function. What are the *statoliths*?
4. Label the following ear structures. Note their functions as you study the ear



Auditory canal, tympanic membrane, malleus, incus, stapes, round window, outer ear, middle ear, inner ear, semicircular canals, cochlea, auditory nerve, Eustachian tube, organ of Corti, hair cells



5. Read the section on “Hearing” very carefully. As you read the second paragraph, and study Figure 50.8, begin writing a list of events. Step 1 is done for you. Prompts are given for the next events.

(1) Moving air waves causes *tympanic membrane* (eardrum) to vibrate.

(2) Bones/*stapes*

(3) *Oval window*

(4) Fluid inside the *cochlea*

(5) *Hair cells*/mechanoreceptors

(6) *Round window*

6. The sense of equilibrium is centered in the inner ear. Explain how the three fluid-filled *semicircular canals* and *otoliths* allow you to detect motion in different planes.

**Concept 50.3 The senses of taste and smell rely on similar sets of sensory receptors**

7. What type of receptor is found in the *taste buds*? List the five types of tastes here.

*Note 1:* Have you ever been asked to do taste tests and draw a map of the tasting areas of the tongue? Any region of the tongue can detect any of the five types of taste!

*Note 2:* Sensations of sweet, umami, and bitter, as well as scent detection, all require a *G protein-coupled receptor* and a *signal transduction pathway* with *second messengers*—just a reminder that this is a common mechanism!

8. As with taste, the receptors for smell are \_\_\_\_\_.

**Concept 50.4 Similar mechanisms underlie vision throughout the animal kingdom**

9. Label this figure of the eye, and give the function of these structures:

**sclera**

**choroid**

**cornea**

**retina**

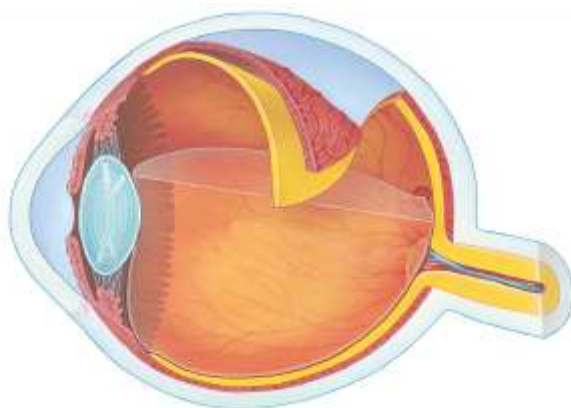
**lens**

**aqueous humor**

**vitreous humor**

**fovea**

**optic nerve**



10. Complete the following chart.

Photoreceptor	Function	Location
<i>rods</i>		
<i>cones</i>		

11. Devise a diagram to show the conversion of *retinal + opsin* to *rhodopsin*. Include light activation as well as return to inactive state. (This is *not* Figure 50.21.)

*Note:* Again, this system uses G proteins and signal transduction.

**Concept 50.5 The physical interaction of protein filaments is required for muscle function**

12. *Skeletal muscle* is attached to bone and *striated*. What does *striated* mean?
13. A single muscle cell is also called a muscle *fiber*. Like a nested doll, each fiber contains the listed structures. As you label the diagram of skeletal muscle, write a description of each term.

**muscle**

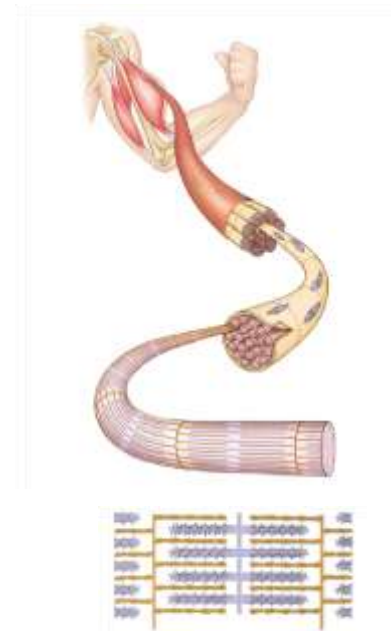
**muscle fiber**

**myofibrils**

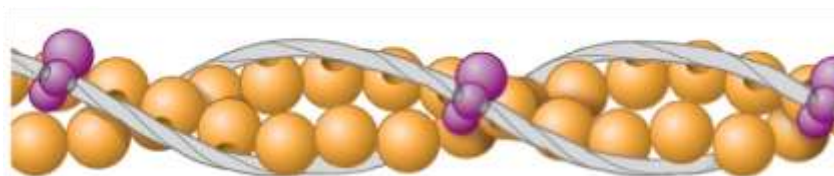
**sarcomere**

**thick filaments**

**thin filaments**

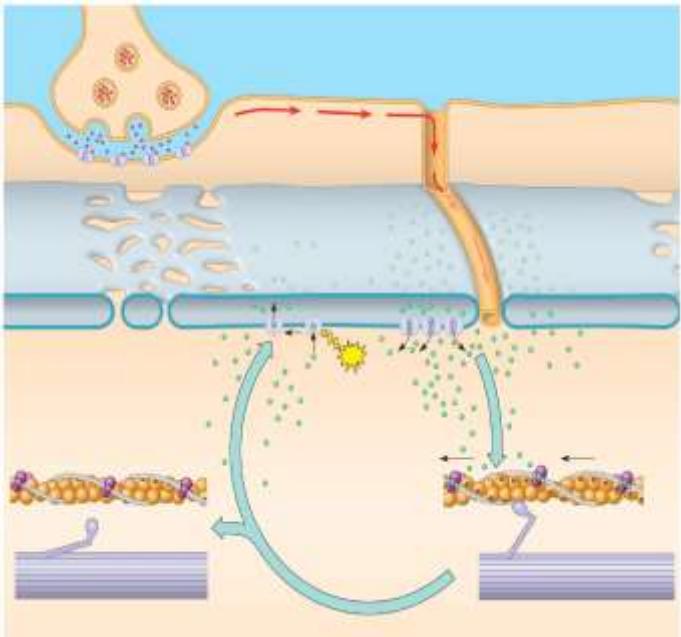


14. The mechanism of muscle contraction is described by the *sliding-filament model*. In the space below, draw a sketch of a *sarcomere* in a relaxed muscle. Below it, draw a sketch of a sarcomere in a contracted muscle. On your figure, label *actin* and *myosin*.
15. Describe the *myosin* molecule.
16. As you see in Figure 50.27, muscle contraction occurs when actin and myosin interact. Myosin heads bind to actin, forming cross-bridges. What molecule binds to myosin to provide the energy of contraction?
17. In the relaxed muscle fiber, the myosin-binding sites are blocked by a regulatory proteins bound to the actin. Use Figure 50.28 to identify the *actin*, *tropomyosin*, *troponin complex*, and *Ca<sup>2+</sup> binding sites*.



18. In a muscle fiber, the specialized endoplasmic reticulum is known as the \_\_\_\_\_.
19. What causes the release of Ca<sup>2+</sup>?
20. As you recall from Chapter 48 on nerve impulse transmission, an action potential will cause release of neurotransmitter at the stimulated neuron's synaptic terminal. Let's put all this together by

studying a single figure. The stimulated neuron is a *motor neuron* that will release the neurotransmitter *acetylcholine*. Label this figure with all possible details.



21. Here is a jumbled summary of steps involved in muscle contraction. Put them into correct order in the chart below, and then place the number for each step in the correct location on the preceding diagram.

- Calcium ions bind to troponin molecules of thin filaments.
- Acetylcholine is released from synaptic vesicles.
- Acetylcholine binds to receptors on the muscle fibers. This allows Na<sup>+</sup> ions to rush, causing depolarization.
- The troponin/tropomyosin complex is moved so the myosin-binding site of actin is exposed.
- Depolarization continues across the sarcolemma and down the transverse tubule system.
- Ca<sup>++</sup> is released from cisterns of the SR (sarcoplasmic reticulum).
- Nerve impulse arrives at the neuromuscular junction.
- Myosin heads rotate, bind the actin, and pull the actin fibers toward the center of the sarcomere.
- In the presence of Ca<sup>++</sup>, myosin acts as an enzyme. It catalyzes breakdown of ATP. Energy is transferred from ATP to the myosin head; myosin is activated.

	<b>Steps of Muscle Contraction</b>
<b>1</b>	

2	
3	
4	
5	
6	
7	
8	
9	

22. What is meant by a *motor unit*?

23. The three types of muscles are *skeletal*, *cardiac*, and *smooth*. Select from these three choices to answer the following questions.

- a) \_\_\_\_\_ has *intercalated disks*.
- b) \_\_\_\_\_ lacks striations.
- c) \_\_\_\_\_ is striated and voluntary.
- d) \_\_\_\_\_ has both *fast-twitch* and *slow-twitch fibers*.
- e) \_\_\_\_\_ is associated with the heart.

**Concept 50.6 Skeletal systems transform muscle contraction into locomotion**

24. Your text describes three types of skeletons. Explain how a *hydrostatic skeleton* works.

25. List three phyla that have a hydrostatic skeleton.

26. What is an *exoskeleton*? From what is it made?

27. Which phylum is characterized by an exoskeleton? \_\_\_\_\_

28. All chordates have an *endoskeleton*. What minerals are common in bone and cartilage?

### *Testing Your Knowledge: Self-Quiz Answers*

Now you should be ready to test your knowledge. Place your answers here:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_