## Chapter 10 Somatic and Special Senses

**Function:** Sensory receptors detect changes in the environment and stimulate neurons to send nerve impulses to the brain.

**Types of Receptors:** Each receptor is more sensitive to a specific kind of environmental change but is less sensitive to others. List the five main types of receptors and describe the environmental change that each type is most sensitive to.

- __________________
- __________________
- __________________
- __________________
- __________________

**Senses:** __________________________ are feelings that occur when the brain interprets sensory impulses. What does the term projection mean when referring to the brain and sensations?

During sensory ________________, sensory impulses are sent at decreasing rates until receptors fail to send impulses unless there is a change in strength of the stimulus.

**Somatic Senses:** Receptors associated with the skin, muscles, joints, and viscera make up the somatic senses.

**Pressure and touch:** Three types of receptors detect touch and pressure.

- ________________ ends of sensory nerve fibers in the epithelial tissues are associated with touch and pressure.
- ________________ corpuscles are flattened connective tissue sheaths surrounding two or more nerve fibers and are abundant in hairless areas that are very sensitive to touch, like the lips. They are large structures of connective tissue and cells that resemble the layers of an onion. They function to detect deep pressure. Draw these receptors.

**Temperature:**

Temperature receptors include two groups of free nerve endings: ________________ receptors and ________________ receptors which both work best within a range of temperatures. Both types of receptors adapt quickly.

Temperatures near 45° C stimulate pain receptors; temperatures below 10° C also stimulate pain receptors and produce a freezing sensation.
Pain:
Pain receptors consist of ________________ nerve endings that are stimulated when tissues are damaged.
Do they adapt easily?

_____________ pain receptors are the only receptors in the organs that produce sensations.
_____________ pain occurs because of the common nerve pathways leading from skin and internal
organs. An example would be a heart attack being felt as pain in the arm or as heartburn.
What is the difference between acute and chronic pain? How do their neurons differ?

Regulation of pain:
A person becomes aware of pain when impulses reach the _______________ in the brain, but the ________
cortex judges the intensity and location of the pain.
Other areas of the brain regulate the flow of pain impulses from the spinal cord and can trigger the release of
chemicals called _______________ and ________________, which inhibit the release of pain
impulses in the spinal cord.
Other chemicals called _________________ released in the brain provide natural pain control.

Special Senses: These include the senses of smell, taste, hearing, static equilibrium, dynamic equilibrium, and sight.

Smell = Olfaction:

Olfactory organs: What type of receptor are the olfactory receptors?

Where are they located?

The receptor cells are _______________ neurons with hairlike ________________ covering the dendrites.
These project into the _________________ cavity.

Nerve pathways:
When olfactory receptors are stimulated, their fibers synapse with neurons in the _______________ ______
lying on either side of the crista galli.
Sensory impulses are first analyzed here, then travel along olfactory ________________ to the limbic system,
and lastly to the olfactory _______________ within the temporal lobes.

Olfactory Stimulation:
Scientists are uncertain of how olfactory reception operates but believe that each odor stimulates a set
of specific protein receptors in cell membranes. The brain interprets different receptor combinations as
an olfactory code.

Do olfactory receptors adapt easily?
**Taste:**

Taste ______ are the organs of taste and are located within bumps called ________ of the tongue and are scattered throughout the _____________ and pharynx.

**Taste Receptors:**

Taste cells (gustatory cells) are modified _________ cells that function as receptors.

Taste cells contain the taste _______ that are the portions sensitive to taste. These protrude from openings called taste _________.

What has to happen to chemicals before they can be tasted (or smelled)?

How many types of taste receptors are there believed to be?

Do taste receptors easily adapt?

**Nerve Pathways:**

Taste impulses travel on which three cranial nerves?

They travel to the __________ ________ in the brainstem and then to the gustatory cortex of the _________________.

**Hearing:**

The ear has external, middle, and inner sections and provides the senses of hearing and equilibrium.

**External ear:**

The external ear consists of the _______________ which collects the sound and then travels down the ______________ ______ _______ towards the middle ear.

**Middle ear:**

The middle ear begins with the eardrum called the __________ ____________, and is an air-filled space (tympanic cavity) housing the tiny bones called the _________________.

What are the names of the three bones?

What happens when the eardrum vibrates against the first of the three bones?

What opening does the last of the bones push against?

The ____________, or _______________, tube connects the middle ear to the throat to help maintain equal air pressure on both sides of the eardrum.

**Inner ear:**

The inner ear is made up of a ___________ labyrinth inside a/an _______________ labyrinth.

Between the two labyrinths is a fluid called _________________.

______________ is a fluid inside the inner labyrinth.
Cochlea:

Within the cochlea, the oval window leads to the upper compartment, called the ________________
______________________, the lower chamber is called the ________________
______________________.

The cochlear duct lies between these two compartments and is separated from the lower one by a membrane
called the ________________ membrane.

The Organ of ___________________ lies on this membrane. It has receptors called ____________
cells.

There is a stiff, partial, overhanging membrane in which the ends of these hair cells are embedded. This membrane is
called the ________________ membrane.

The path of vibration:

- The ________________ funnels the sound as air waves into the ________________ ________________
______________________ which channels it to the eardrum called the ________________ ________________.
- This membrane vibrates converting the impulses to mechanical waves. This moves the three auditory
ossicles which are (in order) ________________, ________________, and ________________.
- Moving these ossicles will amplify the sound. The last one, the ________________, pushes in on the ______
window of the inner ear.
- This sets up waves in the fluid of the inner ear and causes the flexible lower membrane called the 
______________ to move.
- The Organ of Corti rests on this membrane so it also moves, causing the ____________ cells to bend because
they are also embedded in the stiff ________________ membrane.
- This bending causes a nerve impulse.
- Different areas of the basilar membrane react to different sounds.

Nerve pathways:

Nerve fibers carry impulses to the auditory cortices of the temporal lobes where they are interpreted.

Equilibrium:

The sense of equilibrium consists of two parts: static and dynamic equilibrium.

Static equilibrium:

The organs of static equilibrium are located within the bony ___________________ of the inner ear,
inside two expansions of the membranous labyrinth called the ________________ and ________________.

A ________________, consisting of hair cells and supporting cells, lies inside these sacs. The hair
cells are inside a gelatinous material that also contain tiny stones called ________________.

When the head changes position, gravity causes the gelatin and stones to shift, bending hair cells and
generating a nervous impulse.

Nerve pathways:

Impulses travel to the brain via the ________________ branch of the ________________ nerve,
indicating the position of the head.

Dynamic equilibrium:

The three ________________ detect motion of the head, and they aid in balancing the
head and body during sudden movement.
The organs of dynamic equilibrium are called cristae ____________, and are located in the bulbous ___________ of each canal of the inner ear. They are at right angles to each other. Hair cells extend into a dome-shaped gelatinous cupula. Rapid turning of the head or body generates impulses as the cupula and hair cells bend.

Also, mechanoreceptors (called ________________) associated with the joints, and the changes detected by the eyes also help maintain equilibrium.

**Vision**

**Accessory organs:**
Accessory organs, namely the lacrimal apparatus, eyelids, and extrinsic muscles, aid the eye in its function.

The __________ protects the eye from foreign objects and is made up of the thinnest skin of the body. The mucous membrane that lines the inner surface of the eyelid is called the ___________.

The __________ apparatus produces tears that lubricate and cleanse the eye. Two small ducts drain tears into the nasal cavity. Tears also contain an antibacterial enzyme called ___________. The six ________________ muscles of the eye attach to the sclera and move the eye in all directions.

**Outer tunic:**
The outer (fibrous) tunic is the transparent ____________ at the front of the eye, and the white ___________ on the exterior of the eye. Both are tough tissues.

**Middle tunic:**
The ___________ coat is highly vascular and darkly pigmented and performs two functions: to nourish other tissues of the eye and to keep the inside of the eye ___________. The ____________ body forms a ring around the front of the eye and contains ________ muscles and ________________ ligaments. What is their function?

The _______________ chamber (between the cornea and iris) and the _______________ chamber (between the iris and vitreous body and housing the lens) make up the _______________ cavity, which is filled with a fluid called _______________ humor.

**Lens:** What is the ability of the lens to change its shape called?

Why is this important?

**Adjusting for light and dark conditions:**
The _________________ is a thin, smooth muscle that adjusts the amount of light entering the ___________ a hole in its center.

The iris has two types of fibers, what are they?
<table>
<thead>
<tr>
<th>Inner tunic:</th>
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<tbody>
<tr>
<td>The inner tunic consists of the _________________, which contains photoreceptors; the inner tunic covers the back side of the eye to the ciliary body.</td>
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<tr>
<td>In the center is the yellow area, the _______________ _______________ with the _____________ _________ in its center, the point of sharpest vision in the eye.</td>
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<td>Medial to this area is the ______________ ________________, where nerve fibers leave the eye resulting in a blind spot.</td>
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<td>The large cavity of the eye is filled with gel-like ________________ humor.</td>
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<th>Refraction:</th>
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<td>Light waves must bend to be focused, a phenomenon called refraction.</td>
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<tr>
<td>What four parts of the eye do this?</td>
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<td>Two kinds of modified neurons comprise the visual receptors; elongated ________ and blunt-shaped ________.</td>
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<tr>
<td>Which is responsible for color vision?</td>
<td>Which is responsible for black and white vision?</td>
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<td>Which is more acute and why?</td>
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<td>The light-sensitive pigment in rods is ________________, which breaks down into a protein, opsins, and retinal (from vitamin A) in the presence of light. How does this work?</td>
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<tr>
<td>The light-sensitive pigments in cones are also proteins; there are ______ sets of cones, each containing a different visual pigment. How does this work?</td>
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<td>The color perceived depends upon which sets of cones the light stimulates: if all the sets are stimulated, the color is ___________; if none are stimulated, the color is ______________.</td>
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<tr>
<td>The axons of ganglion cells leave the eyes to form the ___________ nerves.</td>
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<tr>
<td>Fibers from the medial half of the retina cross over in the optic _______________.</td>
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<tr>
<td>Impulses are transmitted to the thalamus and then to the visual _______________ of the ______________ lobe.</td>
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