A sensory receptor is a specialized cell or cell process that monitors conditions in the body or the external environment.

Stimulation of the receptor directly or indirectly alters the production of action potentials in a sensory neuron.

The sensory information arriving at the CNS is called a sensation.

A perception is a conscious awareness of a sensation.
Introduction

- **General senses**
  - Sensations of temperature, pain, touch, pressure, vibration, and proprioception (body position)
  - Receptors throughout the body
  - These sensations arrive at the primary sensory cortex, or somatosensory cortex

- **Special senses**
  - Sensations of smell (olfaction), taste (gustation), balance (equilibrium), hearing, and vision
  - Specialized receptor cells that are structurally more complex than those of the general senses
Receptors

- **Receptor specificity** — each receptor responds to one type of stimulus
- **Receptive field** — the area that a receptor monitors
- **Tonic receptors** — always send signals, thus information is based on the frequency of the action potentials
- **Phasic receptors** — send action potentials only if stimulated
- **Peripheral adaptation** — receptors may stop sending AP even if the stimulus is still present
- **Central adaptation** — CNS ignoring a AP from a receptor
Figure 18.1 Receptors and Receptive Fields
Receptors

- **Sensory Limitations**
  - Humans do not have receptors for every possible stimulus.
  - Our receptors have characteristic ranges of sensitivity.
  - A stimulus must be interpreted by the CNS. Our perception of a particular stimulus is an interpretation and not always a reality.
The General Senses

- Receptors for general senses classified by location:
  - *Exteroceptors* provide information about the external environment.
  - *Proprioceptors* monitor body position.
  - *Interoceptors* monitor conditions inside the body.

- Receptors for general senses classified by type of stimulus:
  - *Nociceptors* = tissue damage
  - *Thermoreceptors* = change in temperature
  - *Mechanoreceptors* = physical distortion, contact, or pressure
  - *Chemoreceptors* = chemical composition of body fluids
Figure 18.2 Referred Pain
Figure 18.3 Tactile Receptors in the Skin
Figure 18.3 Tactile Receptors in the Skin
Figure 18.3 Tactile Receptors in the Skin
Figure 18.3 Tactile Receptors in the Skin

(e) Ruffini corpuscle

(d) Tactile corpuscle
Figure 18.3 Tactile Receptors in the Skin
Figure 18.4 Baroreceptors and the Regulation of Autonomic Functions

- **Baroreceptors of Carotid Sinus and Aortic Sinus**: Provide information on blood pressure to cardiovascular and respiratory control centers.
- **Baroreceptors of Digestive Tract**: Provide information on volume of tract segments, trigger reflex movement of materials along tract.
- **Baroreceptors of Lung**: Provide information on lung stretching to respiratory rhythmicity centers for control of respiratory rate.
- **Baroreceptors of Bladder Wall**: Provide information on volume of urinary bladder, trigger urinary reflex.
- **Baroreceptors of Colon**: Provide information on volume of fecal material in colon, trigger defecation reflex.
Figure 18.5 Chemoreceptors

Chemoreceptors in and near respiratory centers of medulla oblongata
Sensitive to changes in pH and \( P_{\text{CO}_2} \) in cerebrospinal fluid

Chemoreceptors of carotid bodies
Sensitive to changes in pH, \( P_{\text{CO}_2} \), and \( P_{\text{O}_2} \) in blood

Chemoreceptors of aortic bodies
Sensitive to changes in pH, \( P_{\text{CO}_2} \), and \( P_{\text{O}_2} \) in blood

Trigger reflexive adjustments in depth and rate of respiration

Via cranial nerve IX

Via cranial nerve X

Trigger reflexive adjustments in respiratory and cardiovascular activity
TABLE 18.1 Touch and Pressure Receptors

<table>
<thead>
<tr>
<th>Sensation</th>
<th>Receptor</th>
<th>Responds to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine touch</td>
<td>Free nerve ending</td>
<td>Light contact with skin</td>
</tr>
<tr>
<td></td>
<td>Tactile disc</td>
<td>As above</td>
</tr>
<tr>
<td></td>
<td>Root hair plexus</td>
<td>Initial contact with hair shaft</td>
</tr>
<tr>
<td>Pressure and vibration</td>
<td>Tactile corpuscle</td>
<td>Initial contact and low-frequency vibrations</td>
</tr>
<tr>
<td></td>
<td>Lamellated corpuscle</td>
<td>Initial contact (deep) and high-frequency vibrations</td>
</tr>
<tr>
<td>Deep pressure</td>
<td>Ruffini corpuscle</td>
<td>Stretching and distortion of the dermis</td>
</tr>
</tbody>
</table>
Olfaction (Smell)

- Olfaction
  - Olfactory organs
    - Nasal cavity
- Olfactory epithelium
  - Bipolar olfactory receptors (N I)
  - Supporting cells
  - Basal cells (stem cells)
- Lamina propria
  - Olfactory glands (Bowman’s glands)
  - Blood vessels
  - Nerves (axons of N I)
Figure 18.6 The Olfactory Organs
Gustation (Taste)

- Gustatory receptors are clustered in taste buds, which contain gustatory cells that extend taste hairs through a taste pore.
- Three types of papillae (epithelial projections) on human tongue:
  - Filiform
  - Fungiform
  - Circumvallate
- Four primary tastes:
  - Salty
  - Bitter
  - Sweet
  - Sour
- Also water and umami (characteristic of broth)
Gustation (Taste)

Figure 18.7 Gustatory Reception
Figure 18.8 Gustatory Pathways
Equilibrium and Hearing

- The Ear
  - External ear
  - Middle ear
    - Auditory ossicles
  - Inner ear
    - Vestible and semicircular canals
      - Equilibrium
    - Cochlea
      - Hearing
Figure 18.9 Anatomy of the Ear
Equilibrium and Hearing

Figure 18.10 The Middle Ear

Copyright © 2009 Pearson Education, Inc., publishing as Pearson Benjamin Cummings
Figure 18.11 Structural Relationships of the Inner Ear
Figure 18.12 Semicircular Canals and Ducts
Figure 18.13 The Function of the Semicircular Ducts, Part I
Figure 18.14 The Function of the Semicircular Ducts, Part II
Figure 18.15a,b  The Maculae of the Vestibule: (a) Vestibular Complex, Anterior View: (b) Structure of the Macula
Figure 18.15c The Maculae of the Vestibule: (c) Macular Function

(c) Macular function
Figure 18.16 Neural Pathways for Equilibrium Sensations
Figure 18.17a The Cochlea and Organ of Corti: (a) Structure and Orientation of the Cochlea
Figure 18.17b The Cochlea and Organ of Corti: (b) Cochlear Section, Diagrammatic
Figure 18.17c The Cochlea and Organ of Corti: (c) Cochlear Section, Photomicrograph
Figure 18.17d The Cochlea and Organ of Corti: (d) Cochlear Chambers
Figure 18.17e The Cochlea and Organ of Corti: (e) Organ of Corti
Figure 18.17f The Cochlea and Organ of Corti: (f) The Receptor Surface of the Organ of Corti
Figure 18.18 Pathways for Auditory Sensations
### TABLE 18.2 Steps in the Production of an Auditory Sensation

1. Sound waves arrive at the tympanic membrane.
2. Movement of the tympanic membrane causes displacement of the auditory ossicles.
3. Movement of the stapes at the oval window establishes pressure waves in the perilymph of the vestibular duct.
4. The pressure waves distort the basilar membrane on their way to the round window of the tympanic duct.
5. Vibration of the basilar membrane causes vibration of hair cells against the tectorial membrane, resulting in hair cell stimulation and neurotransmitter release.
6. Information concerning the region and intensity of stimulation is relayed to the CNS over the cochlear branch of N VIII.
Equilibrium and Balance

Figure 18.27 Vestibular Schwannoma
Vision

- Accessory Structures
  - Eyelids
  - Lacrimal apparatus
- Eye
  - Fibrous tunic
  - Vascular tunic
  - Neural tunic
  - Chambers of the eye
- Visual pathways
Figure 18.19a Accessory Structures of the Eye, Part I: (a) Right Eye, Accessory Structures
Figure 18.19b Accessory Structures of the Eye, Part I: (b) Superficial Dissection of Right Orbit
Figure 18.19c Accessory Structures of the Eye, Part I: (c) Deep Dissection of Right Orbit
Figure 18.20 Accessory Structures of the Eye, Part II
Figure 18.21a, b, c  Sectional Anatomy of the Eye
Figure 18.21e  Sectional Anatomy of the Eye: (e) Horizontal Dissection of Right Eye
Figure 18.21f  Sectional Anatomy of the Eye: (f) Horizontal Section, Superior View
Figure 18.22 The Lens and Chambers of the Eye
Figure 18.23a Retinal Organization (Histological)
Figure 18.23b Retinal Organization (Diagrammatic View)
Figure 18.23c Retinal Organization
Figure 18.24 The Circulation of Aqueous Humor
Figure 18.25 Anatomy of the Visual Pathways, Part I
Figure 18.26 Anatomy of the Visual Pathways, Part II