

PowerLecture:  
Chapter 35  
Sensory Perception  
Section 35.0: Weblinks and InfoTrac

**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 35.0: The History of Sonar
- Section 35.0: Learning to Listen: How Some Vertebrates Evolved Biological Sonar. Sid Perkins. *Science News*, May 14, 2005.

How Would You Vote?

The following is the question for this chapter. See national results below.

- Should we pass laws to lessen noise pollution in the oceans?

Impacts, Issues: A Whale of a Dilemma

- A whale senses the world around it by acoustical cues, which travel five times faster in water than in air
- Whales receive vibrations through their jaws, which transmit sound through fat to the middle ears

Impacts, Issues: A Whale of a Dilemma

- Whales use sound to communicate, find food, coordinate migration, and map their environment
- Loud noises such as submarine-detecting sonar emitted by naval ships can severely damage a whale's internal tissues
- Without the use of sound, whales are completely lost

Section 35.1: Weblinks and InfoTrac

**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 35.1: Seeing, Hearing, and Smelling the World
- Section 35.1: Why Do Animals Have So Many Receptors? Charles Derby et al. *The Biological Bulletin*, Apr. 2001.

Sensory Systems

- The means by which organisms receive signals from the external world and internal environment
- Many animals can sense stimuli that humans cannot
  - Sensory Receptors
  - Convert the energy of a stimulus into action potentials

#### Assessing a Stimulus

- Action potentials don't vary in amplitude
- Brain tells nature of stimulus by:
  - Particular pathway that carries the signal
  - Frequency of action potentials along an axon
  - Number of axons recruited

#### Recordings of Action Potentials

##### Sensory Adaptation

- A decrease in response to a stimulus being maintained at constant strength
  - Section 35.2: Weblinks and InfoTrac
  - See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 35.2:      Sensory Apparatus of the Skin

- Section 35.2:      Using the Brain to Conquer Pain. Norbert Myslinski. *World and I*, Feb. 2003.

#### Somatic Sensations

- Touch
- Pressure
- Temperature
- Pain
- Motion
- Position

#### Somatosensory Cortex

##### Receptors in Skin

- Free nerve ending
- Ruffini ending
- Pacinian corpuscle
- Bulb of Krause
- Meissner's corpuscle

#### Referred Pain

- Sensations of pain from internal organs may be wrongly projected to part of the skin surface
- Heart attack can be felt as pain in skin above the heart and along the left shoulder and arm

Section 35.3: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 35.3: Olfaction—A Review
- Section 35.3: Scents of Time (olfactory memory). Rachel Herz. *The Sciences*, July 2000.

Taste

- A special sense
- Chemoreceptors
- Five primary sensations:
  - sweet, sour, salty, bitter, and umami

Smell

- A special sense
- Olfactory receptors
- Receptor axons lead to olfactory lobe

Section 35.4: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 35.4: Vestibular Disorders Association
- Section 35.4: Dizziness from A to Z
- Section 35.4: Visual-Vestibular Habituation and Balance Training for Motion Sickness. Rose Marie Rine et al. *Physical Therapy*, Oct. 1999.

Balance and Equilibrium

- In humans, organs of equilibrium are located in the inner ear
- Vestibular apparatus

Acceleration-Deceleration

Dynamic Equilibrium

- Rotating head movements cause pressure waves that bend a gelatinous cupula and stimulate hair cells inside it

Section 35.5: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 35.5: Hearing & Sound Education Resources
- Section 35.5: Spirals to Unravel a Mystery (psychology and physiology of hearing). Olivier Burckhardt. *Quadrant*, Jan.–Feb. 2003.

## Properties of Sound

- Ear detects pressure waves
- Amplitude of waves corresponds to perceived loudness
- Frequency of waves (number per second) corresponds to perceived pitch

## Anatomy of Human Ear

### Sound Reception

- Sound waves make the eardrum vibrate
- Vibrations are transmitted to the bones of the middle ear
- The stirrup transmits force to the oval window of the fluid-filled cochlea

### Sound Reception

- Movement of oval window causes waves in the fluid inside cochlear ducts

## Sound Reception

### Section 35.6: Weblinks and InfoTrac

See the **latest Weblinks** and **InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 35.6: How Vision Works
- Section 35.6: Crystal Eyes (vision of trilobites 500 mya). Richard Fortey. *Natural History*, Oct. 2000.

## Vision

- Sensitivity to light does not equal vision
- Vision requires two components
  - Eyes
  - Capacity for image formation in the brain

### Invertebrate Eyes

### Invertebrate Eyes

### Invertebrate Eyes

### Section 35.7: Weblinks and InfoTrac

See the **latest Weblinks** and **InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 35.7: Virtual Cow's Eye Dissection

### Human Eye

### Pattern of Stimulation

- Light rays pass through lens and converge on retina at back of eye
- The image that forms on the retina is upside down and reversed right to left compared with the stimulus

- Brain accounts for this during processing  
Pattern of Stimulation

#### Visual Accommodation

- Adjustments of the lens
- Ciliary muscle encircles lens
- When this muscle relaxes, lens flattens, moves focal point farther back
- When it contracts, lens bulges, moves focal point toward front of eye

#### Section 35.8: Weblinks and InfoTrac

See the **latest Weblinks** and **InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 35.8: Hyperphysics—The Retina of the Human Eye
- Section 35.8: Seeing Is Believing (artificial retina). Victor Chase. *Technology Review*, May–June 1999.

#### Organization of Retina

- Photoreceptors lie at the back of the retina, in front of a pigmented epithelium
- For light to reach the photoreceptors, it must pass layers of neurons involved in visual processing

#### Organization of Retina

- Signals from photoreceptors are passed to bipolar sensory neurons, then to ganglion cells

#### The Photoreceptors

- Rods
  - Contain the pigment rhodopsin
  - Detect very dim light, changes in light intensity
- Cones
  - Three kinds; detect red, blue, or green
  - Provide color sense and daytime vision

#### Receptive Fields

- Restricted areas that influence the activity of individual sensory neurons
- Response of neuron to orientation of bar

#### Retina to Brain

#### Section 35.9: Weblinks and InfoTrac

See the **latest Weblinks** and **InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 35.9: National Eye Institute

- Section 35.9: American Academy of Ophthalmology
- Section 35.9: How LASIK Works
- Section 35.9: Saving Your Sight: Early Detection Is Critical. Michelle Meadows. *FDA Consumer*, Mar.–Apr. 2002.

#### Disorders of the Eye

- Color blindness
- Focusing problems
  - Nearsightedness and farsightedness
- Eye diseases
  - Trachoma
  - Histoplasmosis
  - Herpes simplex infection

#### Disorders of the Eye

- Age-related problems
  - Cataracts
  - Macular degeneration
  - Glaucoma
- Injuries
  - Retinal detachment