PSYCHOLOGY

(8th Edition)
David Myers

PowerPoint Slides
Aneeq Ahmad
Henderson State University

1

Sensation

Chapter 5

2

Sensation

Sensing the World: Some Basic Principles

- Threshold
- Sensory Adaptation

Vision

- The Stimulus Input: Light Energy
- The Eye

3

Sensation

Vision

- Visual Information Processing
- Color Vision

Hearing

- The Stimulus Input: Sound Waves
- The Ear
- Hearing Loss and Deaf Culture

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Sensation

Other Important Senses

- Touch
- Taste
- Smell
- Body Position and Movement

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Sensation & Perception

How do we construct our representations of the external world?

To represent the world, we must detect physical energy (stimulus) from the environment and convert it into neural signals, a process called sensation.

When we select, organize, and interpret our sensations, the process is called perception.

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OBJECTIVE 1| Contrast sensation and perception, and explain the difference between bottom-up and top-down processing.

Bottom-up Processing

Analysis of the stimulus begins with the sense receptors and works up to the level of the brain and mind.

Letter "A" is sensed as a black blotch decomposed into features by the brain and perceived as an "A" by our mind .

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Top-Down Processing

Information processing guided by higher-level mental processes, as we construct perceptions drawing on our experience and expectations.

THE CAT

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Making Sense of Complexity

Our sensory and perceptual processes work together to help us sort out complex images.

"The Forest Has Eyes," Bev Doolittle

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Sensing the World

Senses are nature's gift that suit the organism's needs.

A frog feed on flying insects; A male silkworm moth is sensitive to female sex-attractant odor; and we as human beings are sensitive to sound frequencies that represent the range of human voice.

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Exploring the Senses

1. What stimuli cross our threshold for conscious awareness?
2. Could we be influenced by stimuli too weak (subliminal) to be perceived?
3. Why are we unaware of unchanging stimuli, like a band-aid on our skin?

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Psychophysics

A study of the relationship between physical characteristics of stimuli and our psychological experience of them.

Physical World	Psychological World
Light	Brightness
Sound	Volume
Pressure	Weight
Sugar	Sweet

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22nd October 1850

Relative increase in mental intensity, [Fechner] realized, might be measured in terms of the relative increase in physical energy required to bring it about (Wozniak, 1999).

Gustav Fechner (1801-1887)

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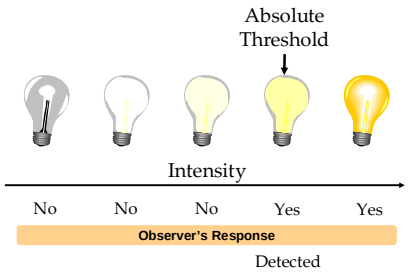
Detection



Tell when you (observer) detect the light.

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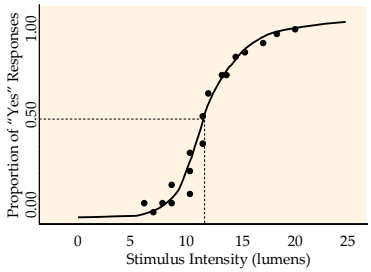
Thresholds

Absolute Threshold: minimum stimulation needed to detect a particular stimulus 50% of the time.



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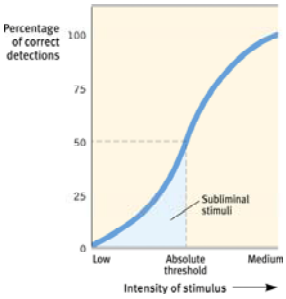
OBJECTIVE 2| Distinguish between absolute and difference thresholds, and discuss whether we can sense stimuli below our absolute thresholds and be influenced by them.

Subliminal Threshold

When stimuli are below one's absolute threshold for conscious awareness.



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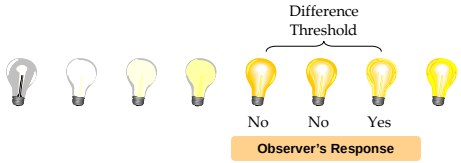
Difference Threshold

Difference Threshold: Minimum difference between two stimuli required for detection 50% of the time, also called just noticeable difference (JND).



Tell when you (observer) detect a difference in the light.

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Weber's Law

Two stimuli must differ by a constant minimum percentage (rather than a constant amount), to be perceived as different. Weber fraction: $k = \delta I / I$.

Stimulus	Constant (k)
Light	8%
Weight	2%
Tone	3%

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Signal Detection Theory (SDT)

Predicts how and when we detect the presence of a faint stimulus (signal) amid background noise (other stimulation). Assumes that there is no single absolute threshold and detection depends on:

Person's experience
Expectations
Motivation
Level of fatigue

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SDT Matrix

The observer decides, whether she hears the tone or not, based on the signal being present or not. This translates into four outcomes.

		Decision: Yes	Decision: No
Signal: Present		Hit	Miss
Signal: Absent		False Alarm	Correct Rejection

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Sensory Adaptation

Diminished sensitivity as a consequence of constant stimulation.

Put a band aid on your arm and after a while you don't sense it.

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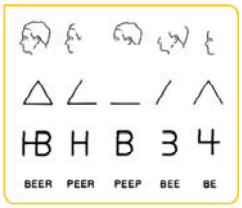
OBJECTIVE 3| Describe sensory adaptation, and explain how we benefit from being unaware of changing stimuli.

Now you see, now you don't

(a)



(b)

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Vision

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Transduction

In sensation, transformation of stimulus energy into neural impulses.

Phototransduction: Conversion of light energy into neural impulses that brain can understand.

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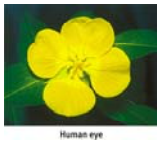
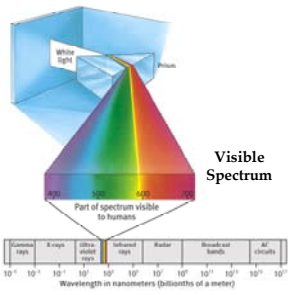
OBJECTIVE 4| Define transduction, and specify the form of energy our visual system converts into neural messages our brain can interpret.

The Stimulus Input: Light Energy





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Light Characteristics

1. Wavelength (hue/color)
2. Intensity (brightness)
3. Saturation (purity)

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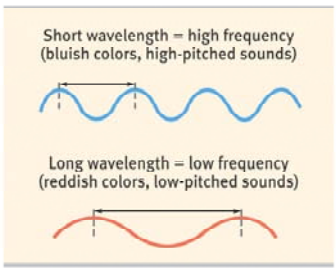
Wavelength (Hue)

Hue (color): dimension of color determined by wavelength of light.

Wavelength the distance from the peak of one wave to the peak of the next.



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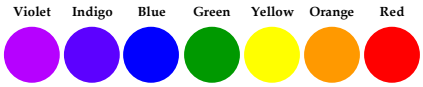
Wavelength (Hue)



400 nm
Short wavelengths

700 nm
Long wavelengths

Different wavelengths of light result in different colors.

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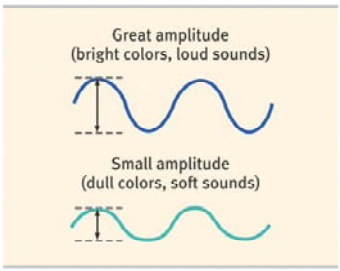
Intensity (Brightness)

Intensity: Amount of energy in a wave determined by amplitude; related to perceived brightness.



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Intensity (Brightness)

Blue color with varying levels of intensity. As intensity increases or decreases, blue color looks more "washed out" or "darkened."

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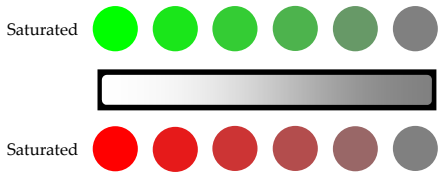
Purity (Saturation)



Monochromatic light added to green and red make them less saturated.

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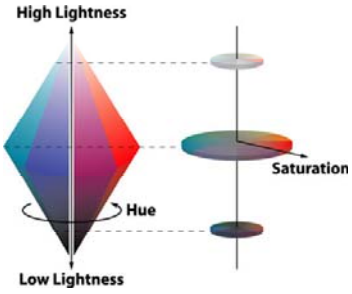
Color Solid

Represents all three characteristics of light stimulus on this model.



http://www.visionconnection.org

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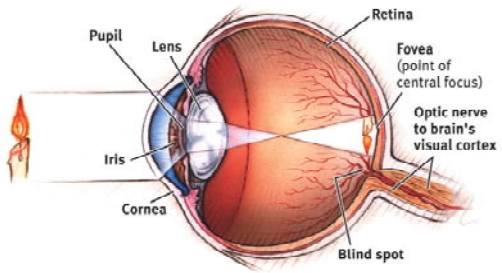
The Eye



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OBJECTIVE 5| Describe the major structure of the eye, and explain how they guide the incoming ray of light toward the eye's receptor cells.

Parts of the eye

1. Cornea: Transparent tissue where light enters the eye.
2. Iris: Muscle that expands and contracts to change the size of opening (pupil) for light.
3. Lens: Focuses the light rays on the retina.
4. Retina: Contains sensory receptors that process visual information and send it to the brain.

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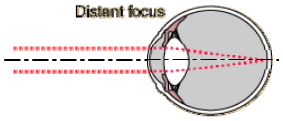
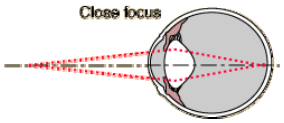
The Lens

Lens: transparent structure behind pupil that changes shape to focus images on the retina.



Accommodation: the process by which the eye's lens changes shape to help focus near or far objects on the retina.



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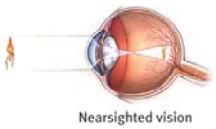
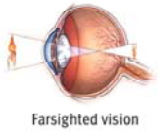
The Lens

Nearsightedness: condition in which nearby objects are seen more clearly than distant objects.



Farsightedness: condition in which faraway objects are seen more clearly than near objects.



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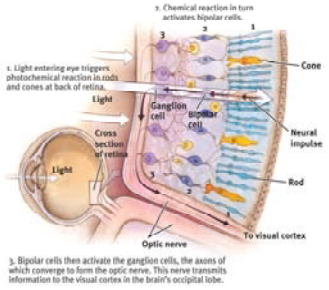
Retina

Retina: The light-sensitive inner surface of the eye, containing receptor rods and cones plus layers of other neurons (bipolar, ganglion cells) that process visual information.



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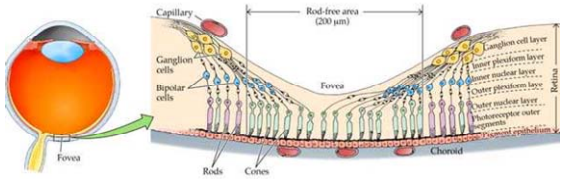
Optic Nerve, Blind Spot & Fovea

Optic nerve: carries neural impulses from the eye to the brain. Blind Spot: point where optic nerve leaves the eye, because there are no receptor cells located here, it creates a blind spot. Fovea: central point in the retina, around which the eye's cones cluster.



http://www.bergen.org

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Test your Blind Spot

Use your textbook. Close your left eye, and with the right eye fixate on the black dot. Move the page towards and away from your eye. At some point the car on the right will disappear due to blind spot.

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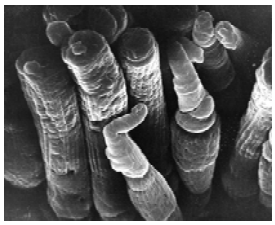
OBJECTIVE 6| Contrast the two types of receptor cells in the retina, and describe the retina's reaction to light.

Photoreceptors



RECEPTORS IN THE HUMAN EYE

	Cones	Rods
Number	6 million	120 million
Location in retina	Center	Periphery
Sensitivity in dim light	Low	High
Color sensitive?	Yes	No
Detail sensitive?	Yes	No

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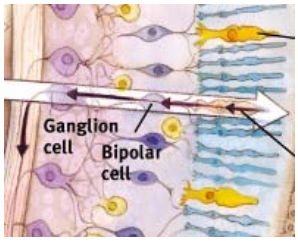
Bipolar & Ganglion Cells

Bipolar cells receive messages from photoreceptors and transmit them to ganglion cells, which for the optic nerve.



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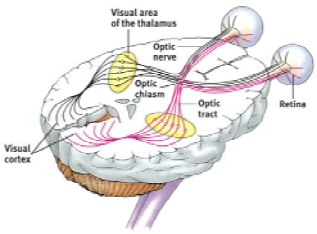
Visual Information Processing

Optic nerves connect to the thalamus in the middle of the brain, and the thalamus to the visual cortex.



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OBJECTIVE 7| Discuss the different levels of processing that occur as information travels from the retina to the brain's cortex.

Ganglion & Thalamic Cells

Retinal ganglion cells and thalamic neurons break down visual stimuli into small components and have receptive fields with center-surround organization.

ON-center OFF-Surround

Action Potentials

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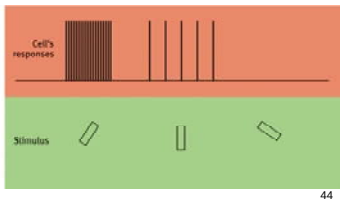
Feature Detection

Nerve cells in the visual cortex respond to specific features, like edges, angle, and movement.



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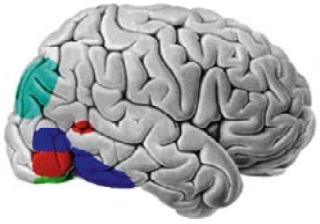
Shape Detection

Specific combinations of temporal lobe activity occur as people look at shoes, faces, chairs and houses.



Faces
Houses
Chairs
Houses and Chairs

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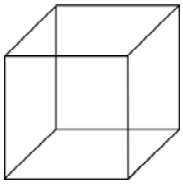
Perception in Brain

Our perceptions are a combination of sensory (bottom-up) and cognitive (top-down) processes.



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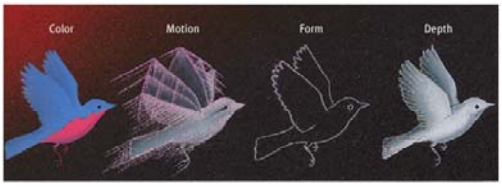
Visual Information Processing

Processing of several aspects of the stimulus simultaneously is called parallel processing. The brain divides a visual scene into subdivisions such as color, depth, form and movement etc.



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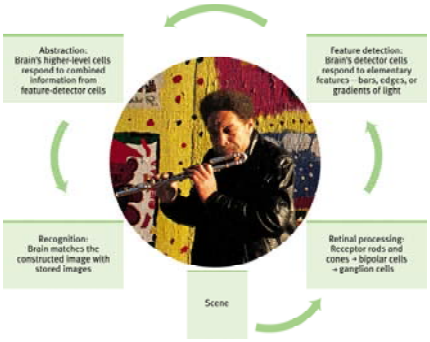
OBJECTIVE 8| Discuss parallel processing and discuss its role in visual processing.

From Sensation to Recognition



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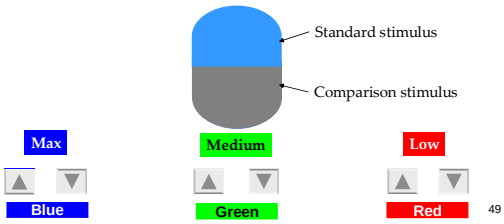
Theories of Color Vision

Trichromatic theory: Based on behavioral experiments, Helmholtz suggested that retina should contain three receptors sensitive to red, blue and green colors.



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OBJECTIVE 9| Explain how the Young-Helmholtz and opponent-process theories help us understand color vision.

Subtraction of Colors

If three primary colors (pigments) are mixed it results in subtraction of all wavelengths and the result is black color.

Subtractive color mixing

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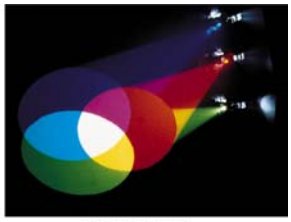
Addition of Colors

If three primary colors (lights) are mixed the wavelengths are added and the result in white color.



Additive color mixing

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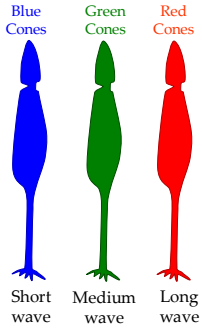
Photoreceptors

MacNichol, Wald and Brown (1967) measured directly the absorption spectra of visual pigments of single cones obtained from the retinas of humans.



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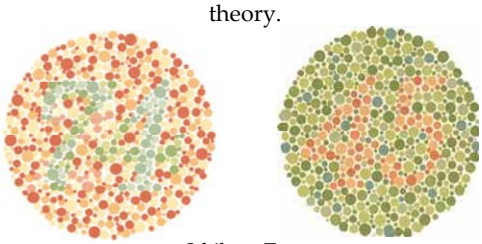
Color Blindness

Genetic disorder in which people are blind to green or red colors supported Trichromatic theory.



Ishihara Test

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Opponent Colors

Gaze at the middle of the flag for about 30 seconds, when it disappears, stare at the dot and report if you see Britain's flag.

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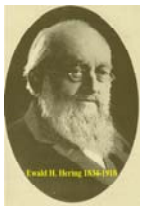
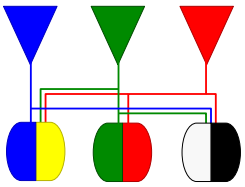
Opponent Process Theory

Hering, proposed that we process four primary colors opposed in pairs of red-green, blue-yellow, and black-white.





Cones

Retinal Ganglion Cells

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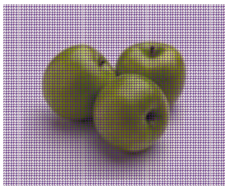
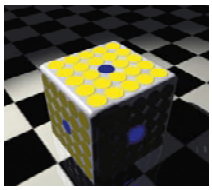
Color Constancy

Color of an object remains the same under different illuminations. However, when context changes color of an object may look different.





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OBJECTIVE 10| Explain the importance of color constancy.

Audition

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The Stimulus Input: Sound Waves

Sound waves are composed of compression and rarefaction of air molecules.

Acoustical transduction: Conversion of sound waves into neural impulses in the hairs cells of the inner ear.

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OBJECTIVE 11| Describe the pressure waves we experience as sound.

Sound Characteristics

1. Frequency (pitch)
2. Intensity (loudness)
3. Quality (timbre)

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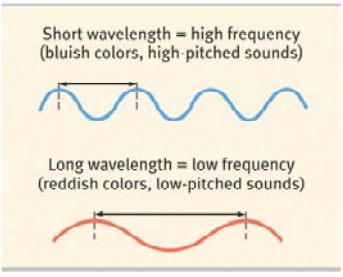
Frequency (Pitch)

Frequency (pitch): dimension of frequency determined by wavelength of sound.

Wavelength the distance from the peak of one wave to the peak of the next.



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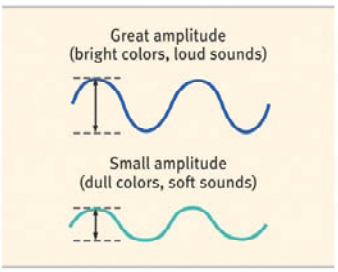
Intensity (Loudness)

Intensity (Loudness): Amount of energy in a wave determined by amplitude relates to perceived loudness.



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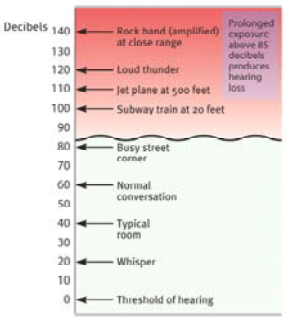
Loudness of Sound



120dB

70dB

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Quality (Timbre)

Quality (Timbre): Characteristics of sound from a zither and a guitar allows the ear to distinguish between the two.

Zither

Guitar

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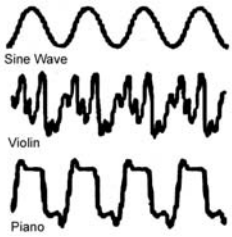
Overtones

Overtones: Make the distinction among musical instruments possible.



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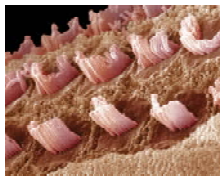
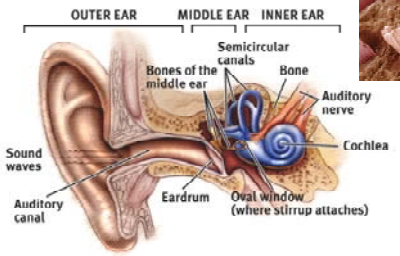
The Ear





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OBJECTIVE 12| Describe the three regions of the ear, and outline the series of events that triggers the electrical impulses sent to the brain.

The Ear

Outer Ear: Pinna. Collects sounds.

Middle Ear: Chamber between eardrum and cochlea containing three tiny bones (hammer, anvil, stirrup) that concentrate the vibrations of the eardrum on the cochlea's oval window.

Inner Ear: Innermost part of the ear, containing the cochlea, semicircular canals, and vestibular sacs.

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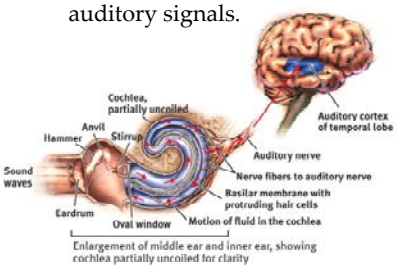
Cochlea

Cochlea: coiled, bony, fluid-filled tube in the inner ear that transduces sound vibrations to auditory signals.



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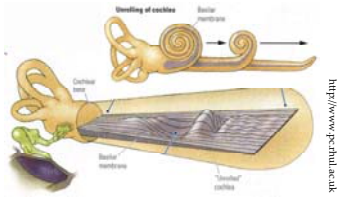
Theories of Audition

Place Theory: Suggests that sound frequencies stimulate basilar membrane at specific places resulting in perceived pitch.



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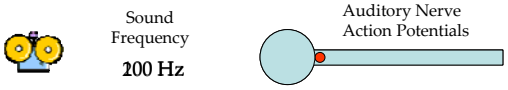
OBJECTIVE 13| Contrast place and frequency theories, and explain how they help us to understand pitch perception.

Theories of Audition

Frequency Theory: States that the rate of nerve impulses traveling up the auditory nerve matches the frequency of a tone, thus enabling us to sense its pitch.



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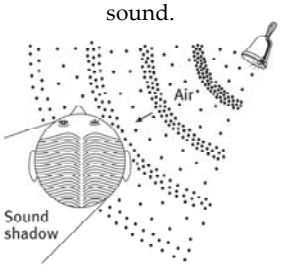
Localization of Sounds

Because of two ears sounds that reach one ear faster than the other makes us localize the sound.



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OBJECTIVE 14| Describe how we pinpoint sounds.

Localization of Sound

1. Intensity differences
2. Time differences

Time differences as small as 1/100,000 of a second can lead to localize sound. Head acts as "shadow" or partial sound barrier.

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Hearing Loss

Conduction Hearing Loss: Hearing loss caused by damage to the mechanical system that conducts sound waves to the cochlea.

Sensorineural Hearing Loss: Hearing loss caused by damage to the cochlea's receptor cells or to the auditory nerve, also called nerve deafness.

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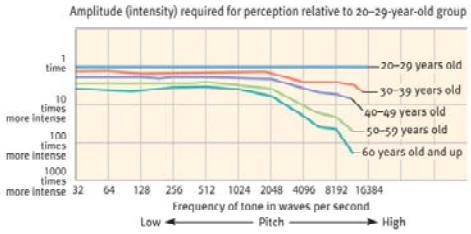
OBJECTIVE 15| Contrast two types of hearing loss, and describe some of their causes.

Hearing Deficits

Older people tend to hear low frequencies well but suffer hearing loss for high frequencies.



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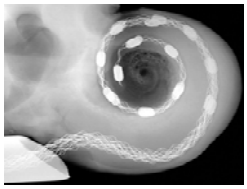
Deaf Culture

Cochlear implants are electronic devices that enable the brain to hear sounds.

Deaf Musician



Cochlear Implant

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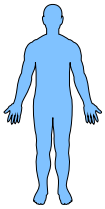
OBJECTIVE 16| Describe how cochlear implants function, and explain why Deaf culture advocates object to these devices.

Other Important Senses

Sense of touch is a mix of four distinct skin senses- pressure, warmth, cold, and pain.



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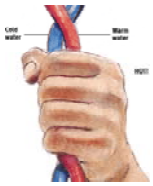
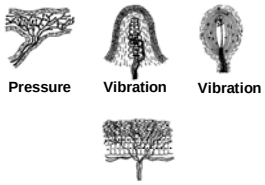
OBJECTIVE 17| Describe the sense of touch. "Touch is both the alpha and omega of affection" (James, 1890).

Skin Senses

Only pressure has identifiable receptors, all other skin sensations are variations of pressures, warmth, cold and pain.



Burning hot



Cold, warmth and pain

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Pain

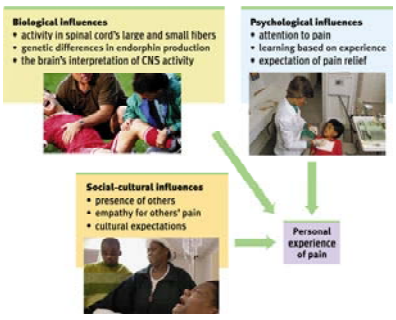
Pain tells the body that something has gone wrong. Usually pain results from damage to the skin and other tissues. There is a rare disease in which the person feels no pain.

Ashley Blocker (right) feels neither pain nor extreme hot or cold.

77

OBJECTIVE 18| State the purpose of pain, and describe the biopsychosocial perspective on pain.

Biopsychosocial Influences



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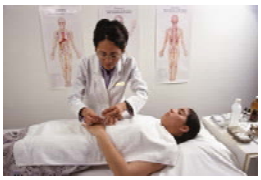
Gate-Control Theory

Melzak and Wall (1965, 1983) proposed that our spinal cord contains neurological "gates" that either block pain or allow it to be sensed.



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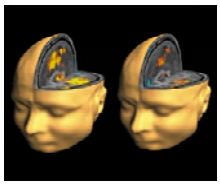
One way to treat chronic pain is to stimulate it through massage by electrical stimulation or acupuncture. Rubbing causes competitive stimulation to pain thus reduces its effect.

Pain Control

Pain can be controlled by a number of therapies including, drugs, surgery, acupuncture, exercise, hypnosis and even thought distraction.



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Burn victims can be distracted by allowing them to engage in illusory virtual reality. Their brain scans show differences in pain perceptions.

Taste

Traditionally taste sensations consisted of sweet, salty, sour and bitter tastes. Recently receptors for a fifth taste have been discovered called *"Umami"*.

Sweet

Sour

Salty

Bitter

Umami (Fresh Chicken)

81

OBJECTIVE 19| Describe the sense of taste, and explain the principle of sensory interaction.

Sensory Interaction

When one sense affects another sense sensory interaction takes place. So taste of strawberry interacts with its smell and its texture on the tongue to produce flavor.

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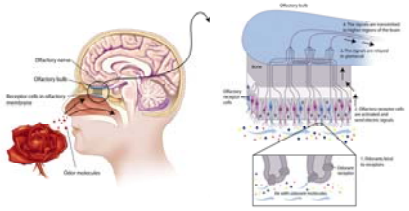
Smell

Like taste smell is a chemical sense. Odorants enter the nasal cavity to stimulate 5 millions receptors to sense smell. Unlike taste there are many different forms of smells.



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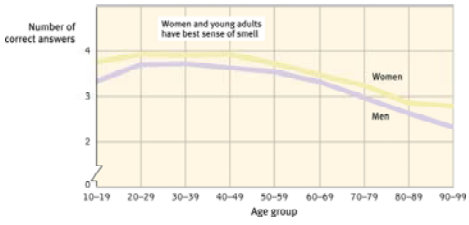
OBJECTIVE 20| Describe the sense of smell and explain why specific odors so easily trigger memories.

Age, Gender and Smell

Ability to identify smell peaks during early adulthood but steadily decline after that. Women are better at detecting odors than men.



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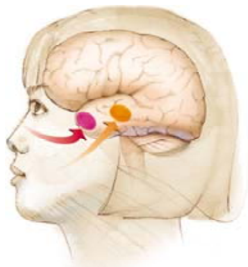
Smell and Memories

Brain region (red) for smell is closely connected with brain regions (limbic system) involved with memory, that is why strong memories are made through the sense of smell.



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OBJECTIVE 21 | Distinguish between kinesthesis and vestibular sense.

Body Position and Movement

The sense of our body parts' position and movement is called kinesthesis. And the vestibular sense monitors the head (and body's) position.

Whirling Dervishes

Wire Walk

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