

Module 16: Basic Principles of Sensation and Perception

- **Sensation**: Process of detecting physical energies with sensory organs
- **Perception**: Mental process of organizing sensations into meaningful patterns
- **Bottom Up Processing**: starts as the sensory level and works up to higher levels of processing
- **Top Down Processing**: constructs perception from the sensory input by drawing on our experiences and expectation

[Top Down/Bottom Up Video](#)

Selective Attention: your awareness that focuses on certain stimuli

-11,000,000 bits of information per second; you process about 40

Cocktail Party Effect – your ability to attend to only one voice among many (while also being able to detect your own name in an unattended voice)

Cocktail Party Effect





Inattentional Blindness: failing to see visible object when our attention is directed elsewhere

-Basketball game and person with umbrella

Change Blindness: form of inattention blindness when we fail to notice changes made

Video link

- **Transduction**: Process of conversion of one form of energy into another
- **Psychophysics**: Study of relationship between the psychical characteristics of stimuli and our psychological experience of them
- **Absolute Thresholds**: minimum amount of stimulation necessary to detect light, sound, pressure, or odor

Absolute Threshold		
The weakest amount of a stimulus that a person can detect 50% of the time.		
Sight		Seeing a candle flame 30 miles away on a clear night
Hearing		Hearing a watch ticking 20 feet away
Touch		Feeling a bee's wing falling a distance of 1cm onto your cheek
Smell		Smelling one drop of perfume in a three room house
Taste		Tasting one teaspoon of sugar dissolved in two gallons of water

- **Signal Detection Theory**: predicts how and when we detect the presence of a faint stimuli (signal) amid background stimulation (noise)

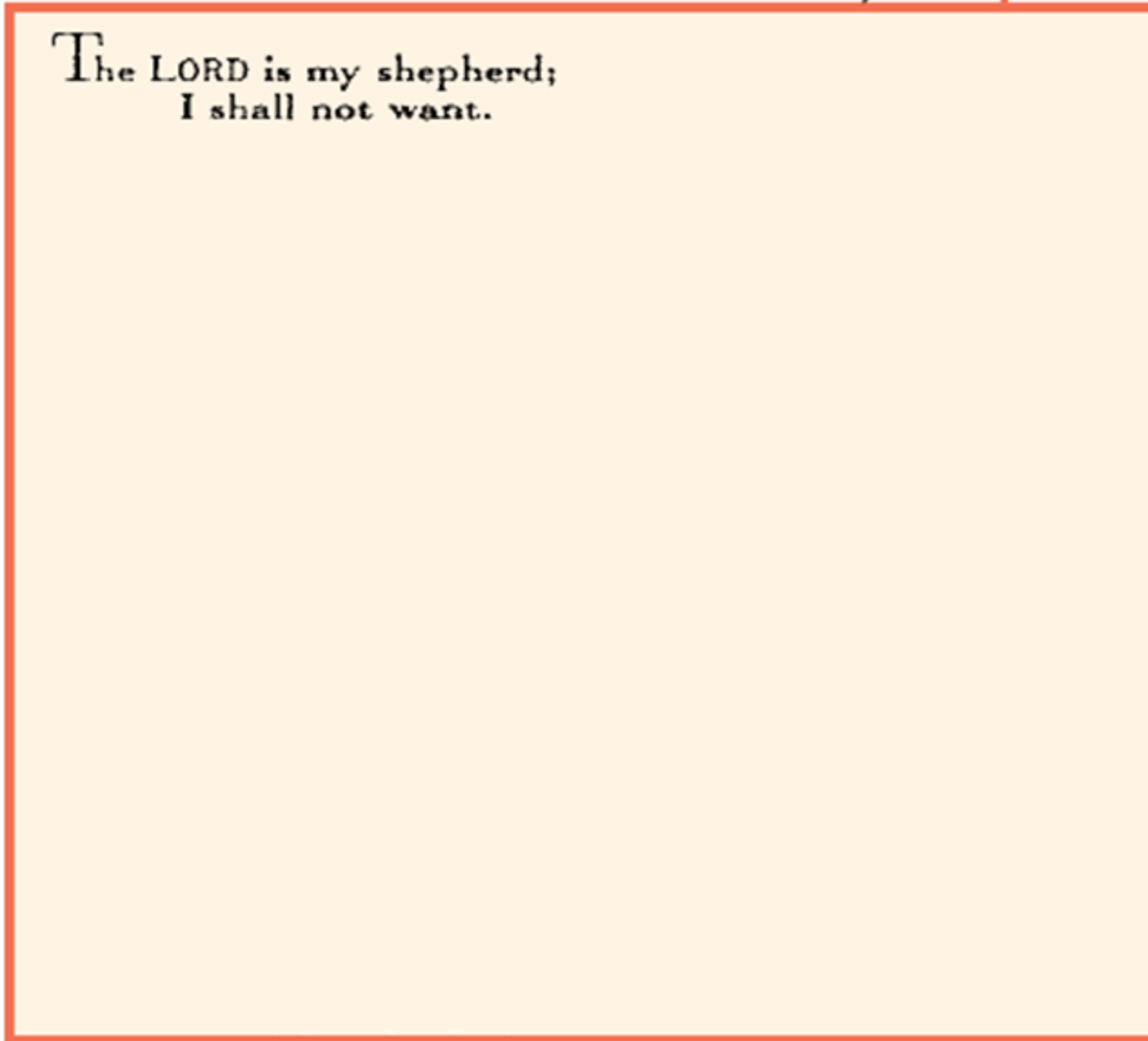
For example, when you walk to your car that is parked in an empty parking lot late at night all by yourself, you might be much more aware of noises because the situation is somewhat threatening (you are primed and listening carefully to hear anything and everything). In this case, you may hear some slight noises that you might otherwise not hear if you were in a different situation that was not as threatening. Thus, your ability to detect signals or noises has been affected by these factors. See what I mean?

Readmore: <http://www.alleydog.com/glossary/definition.php?term=Signal%20Detection%20Theory#ixzz4LYDjgTkG>

Subliminal: below one's absolute threshold for conscious awareness

Priming: activation, often unconsciously, of certain associations, thus predisposing one's perceptions, memory or response

Difference Threshold: Just Noticeable Difference



Minimal difference a person can detect

He maketh me to lie down
in green pastures:

he leadeth me
beside the still waters.

He restoreth my soul:
he leadeth me

in the paths of righteousness
for his name's sake.

Yea, though I walk through the valley
of the shadow of death,

I will fear no evil:
for thou art with me;

thy rod and thy staff
they comfort me.

Thou preparest a table before me
in the presence of mine enemies:

thou anointest my head with oil,
my cup runneth over.

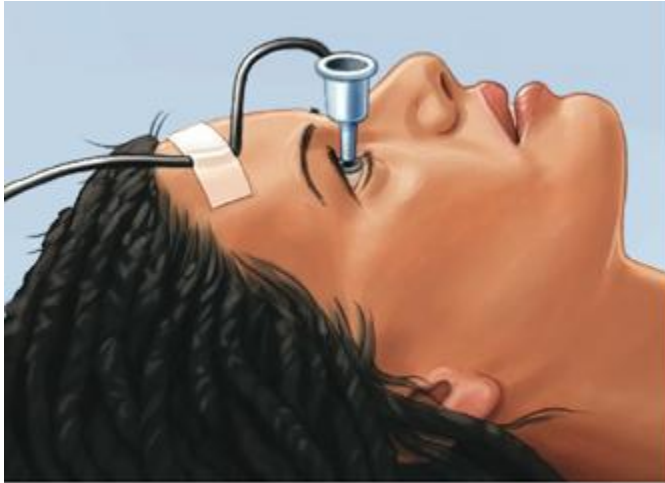
Surely goodness and mercy
shall follow me
all the days of my life:

and I will dwell
in the house of the LORD
for ever.

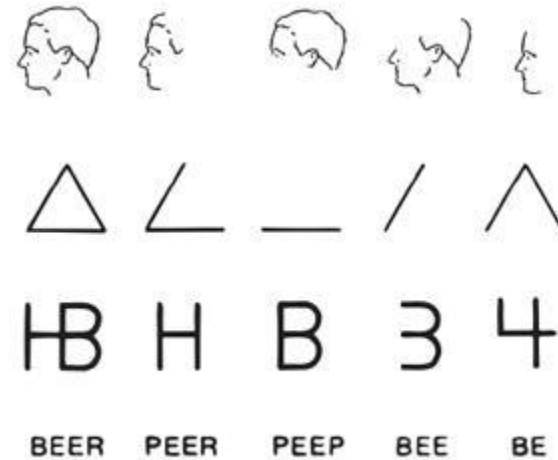
The LORD is my shepherd;
I shall not want.
He maketh me to lie down
in green pastures:
he leadeth me
beside the still waters.
He restoreth my soul:
he leadeth me
in the paths of righteousness
for his name's sake.
Yea, though I walk through the valley
of the shadow of death,
I will fear no evil:
for thou art with me;
thy rod and thy staff
they comfort me.
Thou preparest a table before me
in the presence of mine enemies:
thou anointest my head with oil,
my cup runneth over.
Surely goodness and mercy
shall follow me
all the days of my life:
and I will dwell
in the house of the LORD
for ever.

Weber's Law: average person to perceive difference between two stimuli is must differ by a constant minimum percentage

Sensory Adaptation: diminished sensitivity as consequence of constant stimuli



(a)



(b)

Emotional Adaptation: our visual system adapts to a static facial expression by becoming less responsive to it

Module 17: Influences on Perception

Perceptual Set: mental predisposition to perceive one thing and not another

- Using past experiences to judge how to handle a situation.
- People's expectations for something; this can be good or bad.

Example:
Stereotypes



old woman



young woman

Context Effects: context creates an expectation that includes our perception (top down)

Context makes stimuli look different even though there has been no physical change.

**Seeing your teacher outside of school*

Motivation and Emotion: hearing sad music can predispose people to perceive a sad meaning in spoken homophonic words:

Mourning rather than morning

Die rather than dye

Pain rather than pane

Extrasensory Perception: claim that perception can occur without sensory input

Parapsychology: the study of paranormal phenomena, including ESP and psychokinesis

Three Testable forms of ESP:

- telepathy: mind to mind communication
- clairvoyance: perceiving remote events
- precognition: perceiving future events

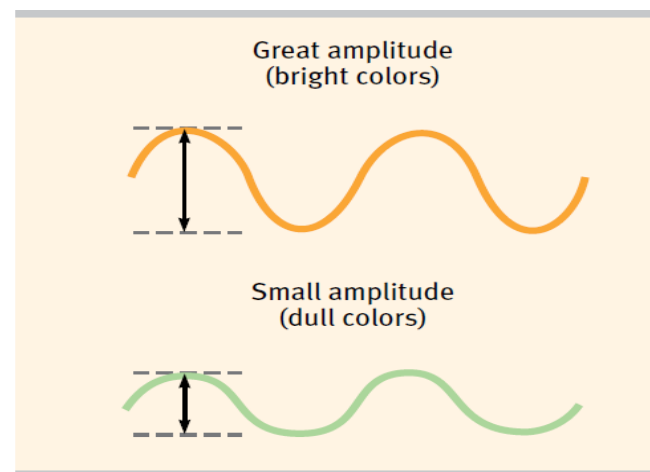
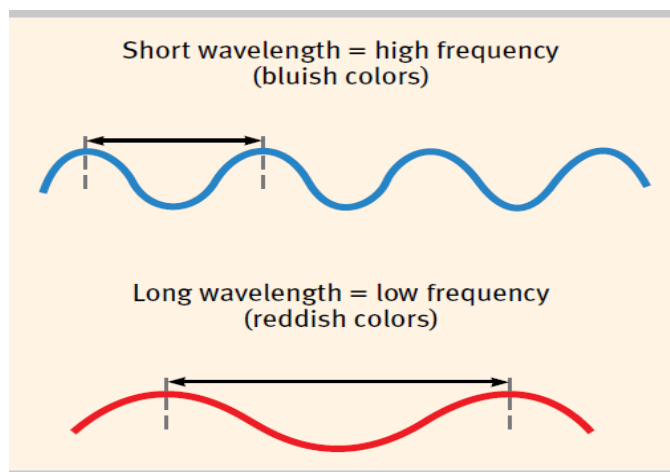
Module 18: Vision

Stimulus Input: Light Energy

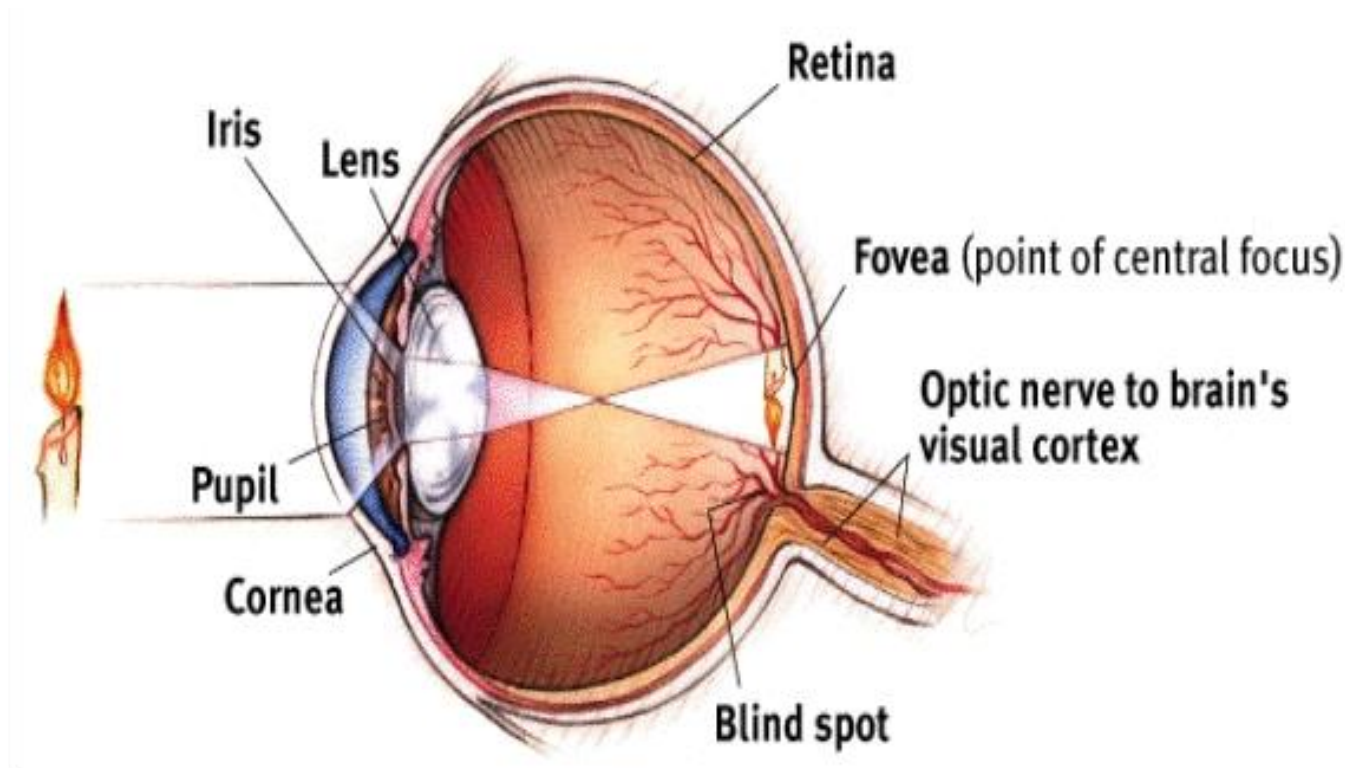
Wavelength – distance from the peak of one light or sound wave to the peak of the next

Hue – dimension of color that is determined by wavelength

Intensity – amount of energy in a light or sound wave, which we perceive as brightness or loudness as determined by the wave's amplitude



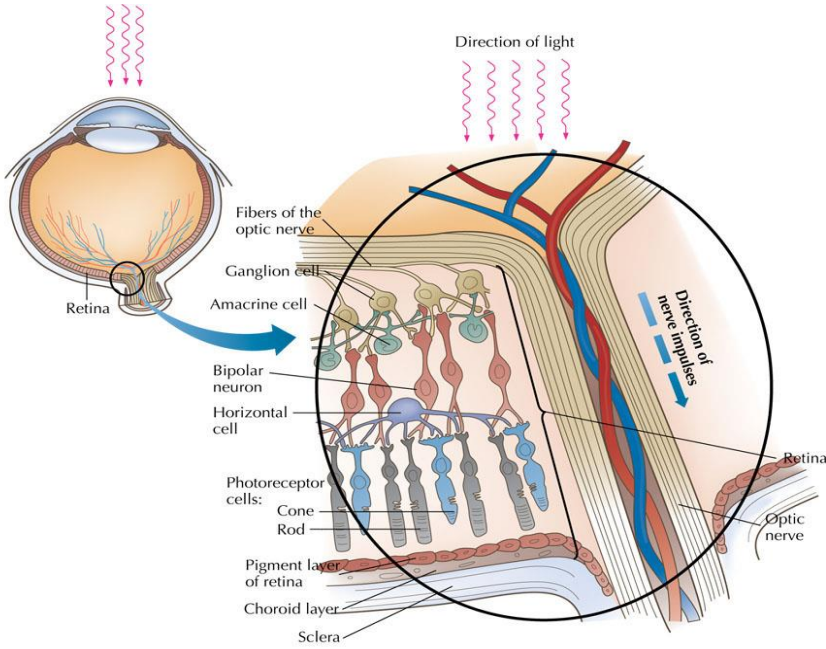
- Pupil:* Opening light passes through
- Iris:* Ring of muscle tissue that forms the colored portion of the eye around the pupil and controls size of opening
- Lens:* Focuses incoming light rays onto an image on the retina
- Retina:* Multilayered tissue on the eyeball's inner surface
- Fovea:* Retina's area of central focus
- Blind Spot:* Where the optic nerve leaves the eye; no receptor cells



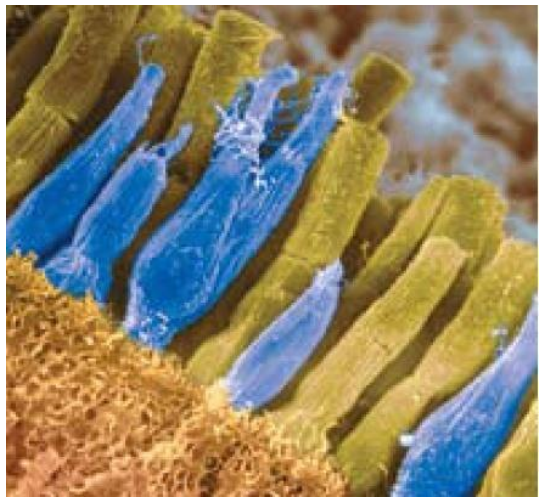
Retina

Rods: Retinal receptors; black, white and gray
* necessary for peripheral vision and twilight vision

Cones: Retinal receptors; fine detail and color
* necessary for daylight or in well-lit conditions
* cluster in and around fovea



Cones



Rods

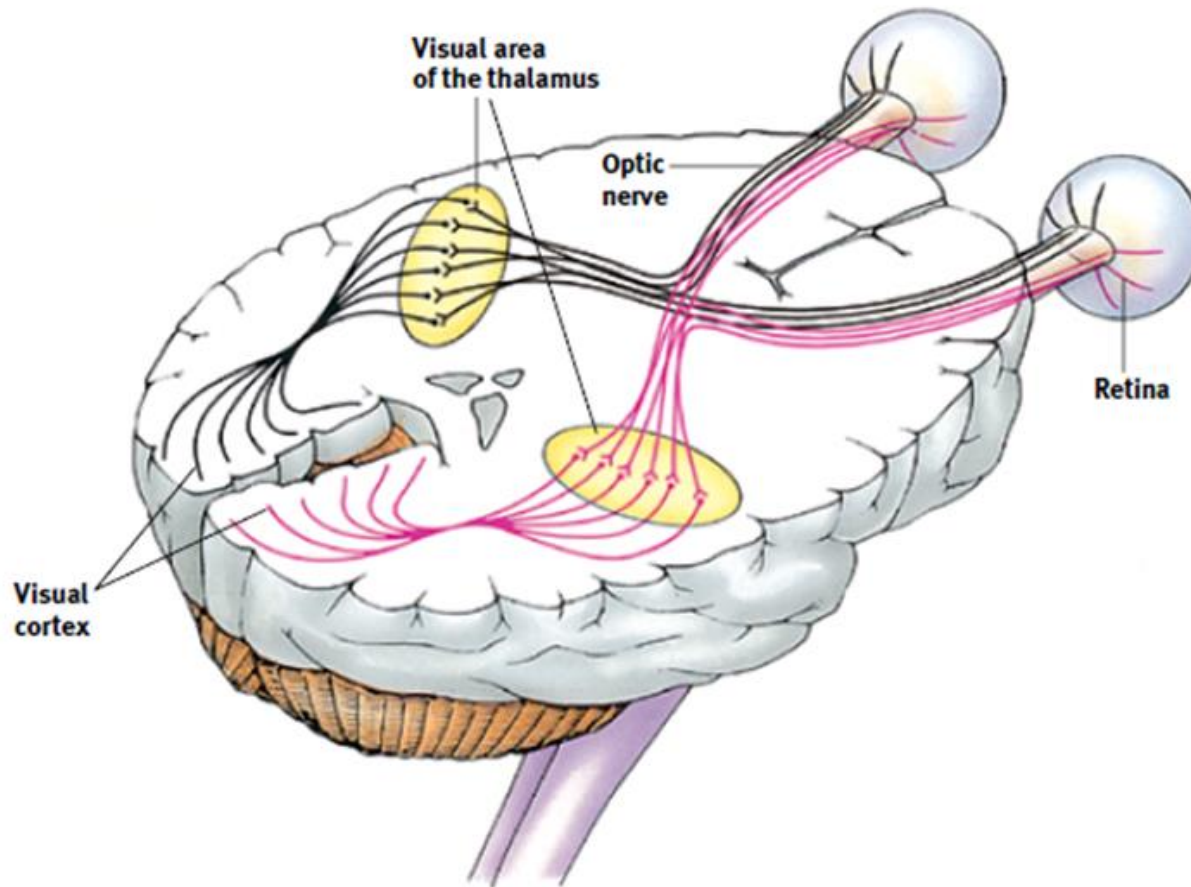
RECEPTORS IN THE HUMAN EYE: ROD-SHAPED RODS AND CONE-SHAPED CONES

	Cones	Rods
Number	6 million	120 million
Location in retina	Center	Periphery
Sensitivity in dim light	Low	High
Color sensitivity	High	Low
Detail sensitivity	High	Low

[How You See Color](#)

Visual Processing

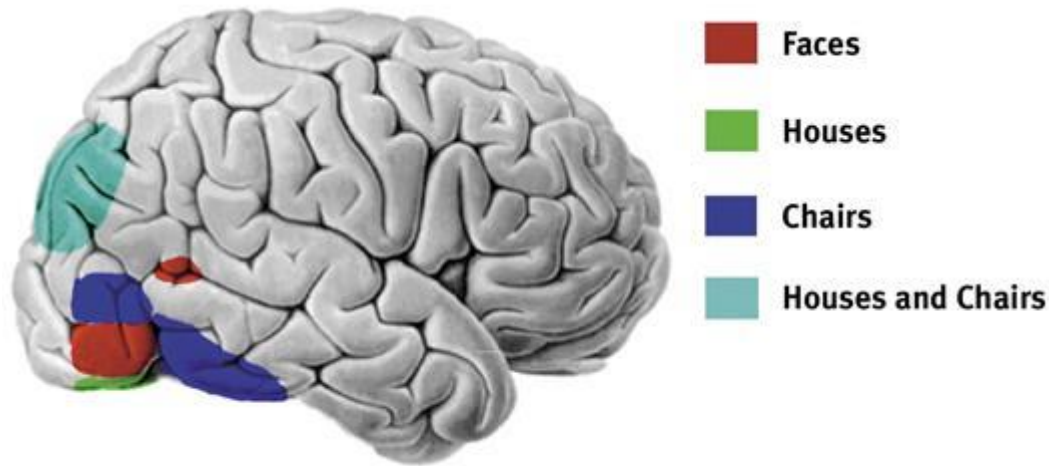
Retina (Rods and Cones) - Bipolar Cells - Ganglion Cells – Optic Nerve - Thalamus - Visual Cortex (Occipital Lobe)



Feature Detectors

Specialized neurons in the occipital lobe's visual cortex

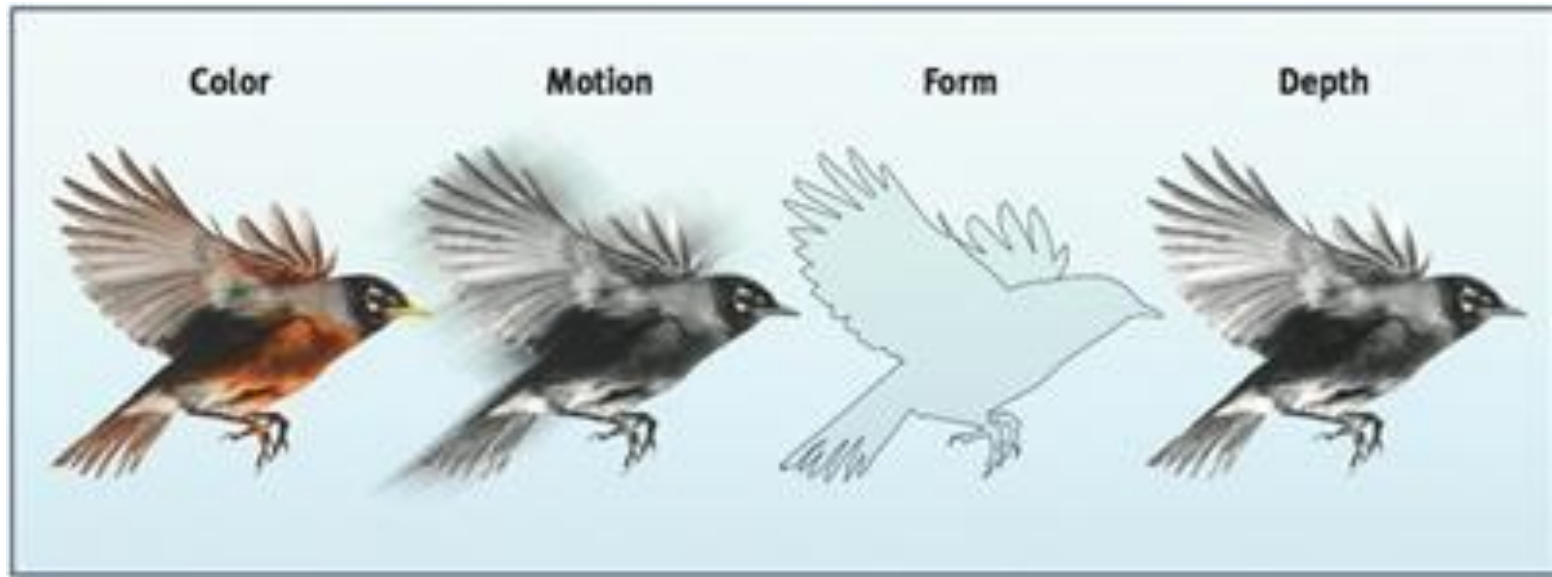
- Derived their name from ability to respond to a scene's specific features (Edges, lines, angles and movement)*
- These cells pass this information to other cortical areas where supercell clusters respond to complex patterns*

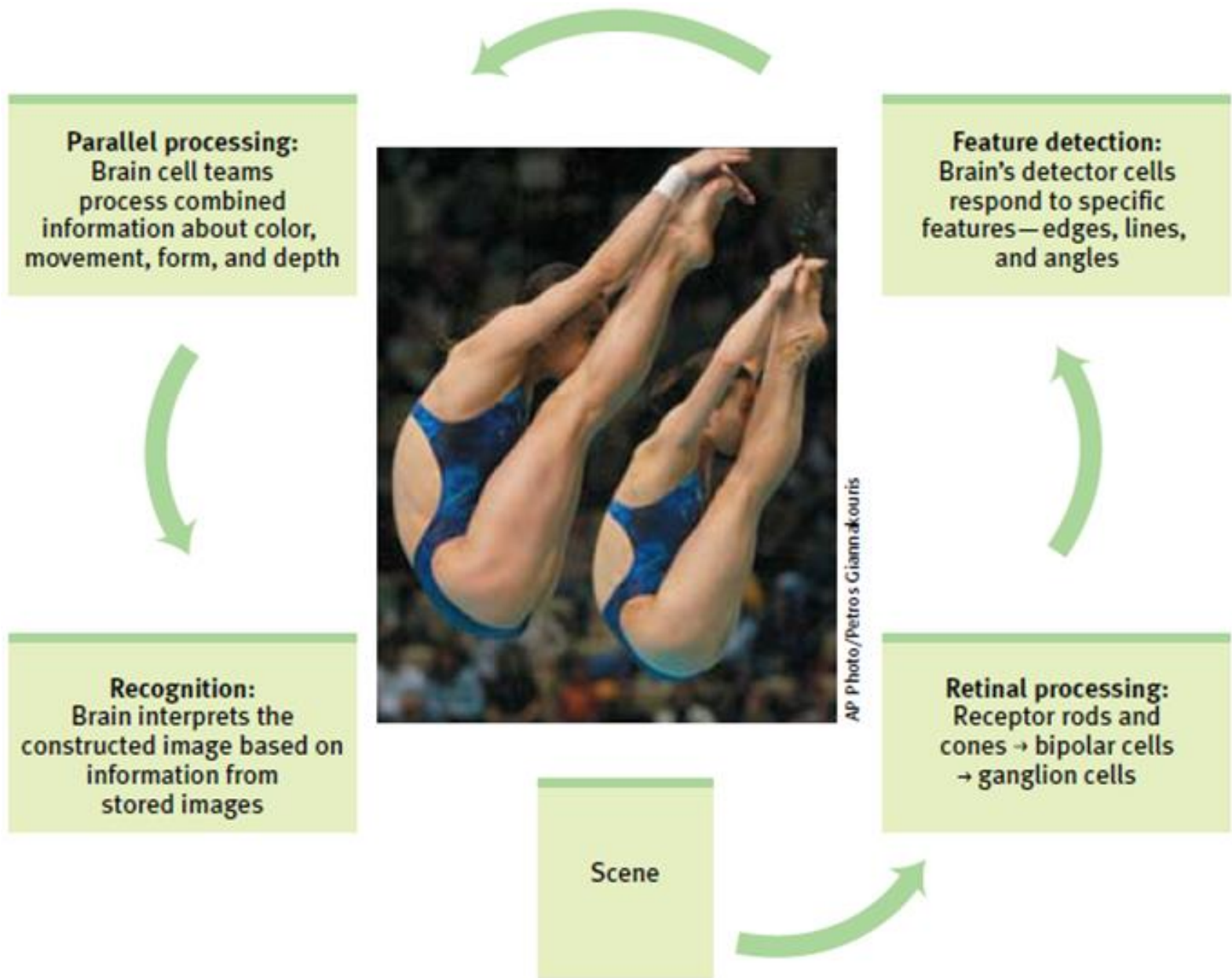


Parallel Processing

Processing of many aspects of a problem simultaneously

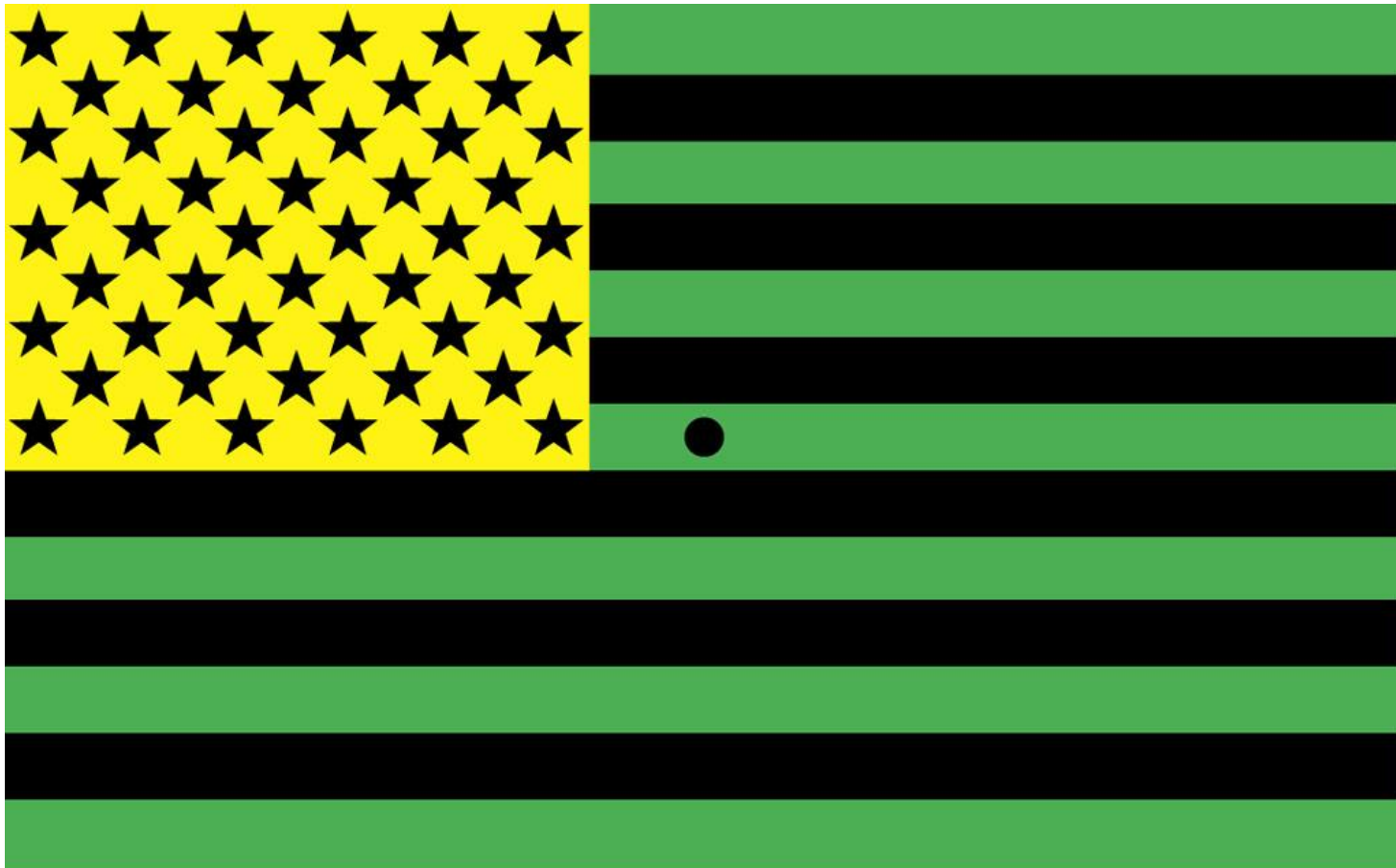
- To recognize a face brains integrate information project by retinas to cortex areas, compares with stored information and allows for recognition





Color Vision

- **Trichromatic Theory**: Color vision theory that states we have three cone types: red, green, blue
 - Other colors produced by a combination of these
 - Black and white produced by rods
- **Opponent Process Theory**: Color vision theory based on three “systems”:
red or green, blue or yellow, black or white
 - Exciting one color in a pair (red) blocks the excitation in the other member of the pair (green)
 - Afterimage: Visual sensation that remains after stimulus is removed (seeing flashbulb after the picture has been taken)



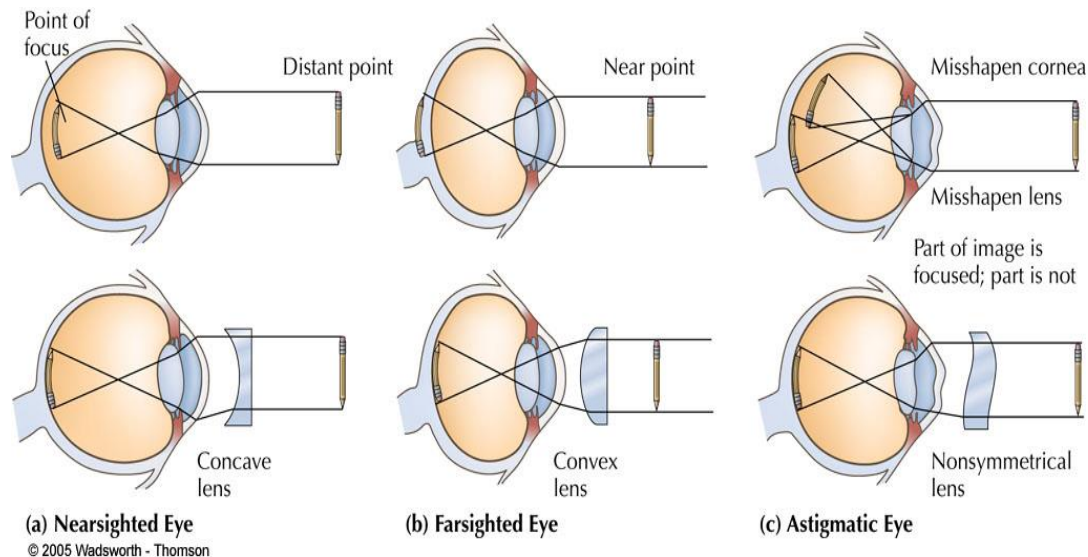
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FIGURE 4.9 Negative afterimages. Stare at the dot near the middle of the flag for at least 30 seconds. Then look immediately at a plain sheet of white paper or a white wall. You will see the American flag in red, white, and blue. Reduced sensitivity to green, black, and yellow in the visual system, caused by prolonged staring, produces the complementary colors.

[Spinning Wheel Illusion](#)

Vision Problems

- **Hyperopia**: Difficulty focusing nearby objects (farsightedness)
- **Myopia**: Difficulty focusing distant objects (nearsightedness)
- **Astigmatism**: Corneal, lens, or eye defect that causes some areas of vision to be out of focus; relatively common
- **Presbyopia**: Farsightedness caused by aging



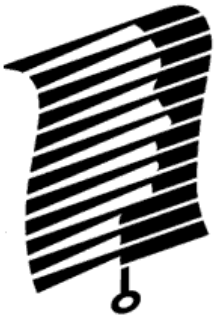
Gestalt Principle of Organization: The Law of Figure-Ground

Figure and Ground

The eye differentiates an object from its surrounding area. a form, silhouette, or shape is naturally perceived as **figure** (object), while the surrounding area is perceived as **ground** (background).

Balancing figure and ground can make the perceived image more clear. Using unusual figure/ground relationships can add interest and subtlety to an image.

The word above is **clearly perceived** as figure with the surrounding white space ground.



In this image, the figure and ground relationships **change** as the eye perceives the the form of a shade or the silhouette of a face.

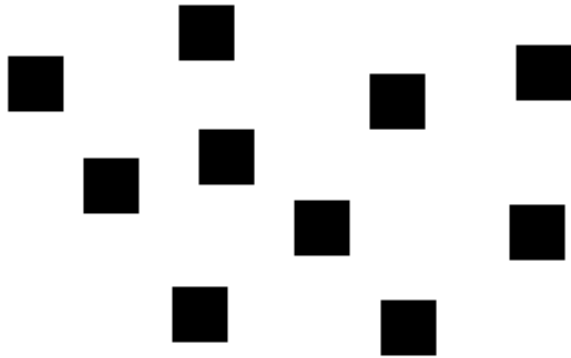


This image uses **complex** figure/ground **relationships** which **change** upon perceiving leaves, water and tree trunk.



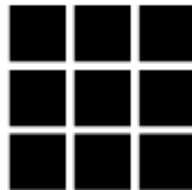
Proximity

Proximity occurs when elements are placed close together. They tend to be perceived as a group.



The nine squares above are placed without proximity. They are perceived as **separate shapes**.

Gestalt Principle of Organization: The Law of Proximity



When the squares are given close proximity, unity occurs. While they continue to be separate shapes, they are now perceived as **one group**.

Gestalt Principle of Organization: The Law of Continuity



Continuity

Continuation occurs when the eye is compelled to **move through** one object and **continue** to another object.



Continuation occurs in the example above, because the viewer's eye will naturally follow a line or curve. The smooth flowing crossbar of the "H" leads the eye directly to the maple leaf.

Gestalt Principle of Organization: The Law of Closure

Closure occurs when an object is *incomplete* or a space is not *completely enclosed*. If enough of the shape is indicated, people perceive the whole by filling in the missing information.



Although the panda above is not complete, enough is present for the eye to complete the shape. When the *viewer's perception completes a shape*, **closure** occurs.

I cdnuolt blveiee taht I cluod aulacly uesdnatnrd waht I was rdanieg. The phaonmneal pweor of the hmuan mnid. Aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it deson't mttar in waht oredr the ltteers in a wrod are, the olny iprmoatnt tihng is that the frist and lsat ltteer be in the rghit pclae. The rset can be a taotl mses and you can sitll raed it wouthit a porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.

*So, you think you're a pretty
pretty good reader. Then I bet you
you see the problem in the
the words that you are
are reading right now
now. If you don't, then
then you better rethink your
your ability.*

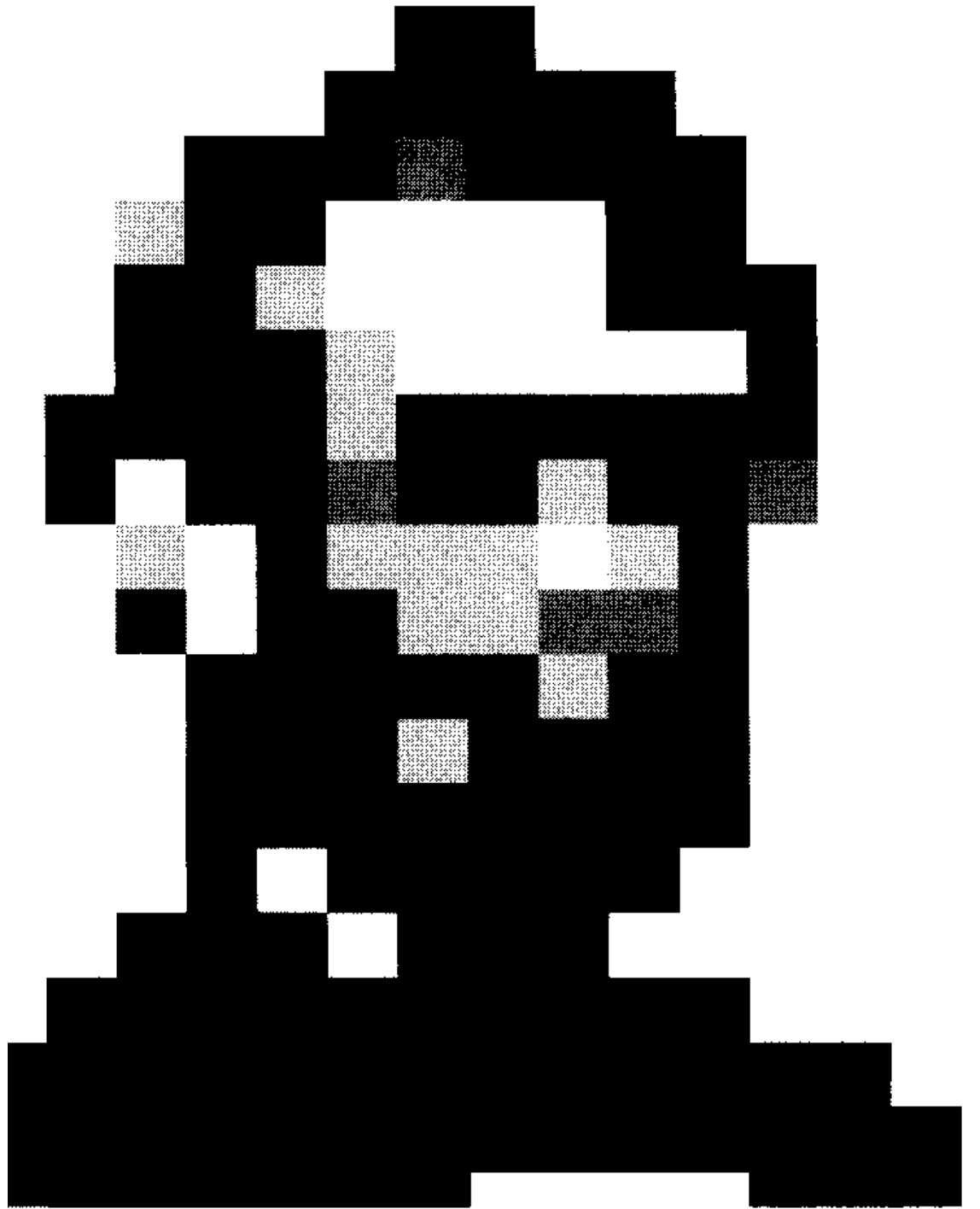
This sentence is very easy to read, but it is not just because you can see all of the letters in each word.

This sxntence is missixg a few letxers, but it can be read wxth little extra exfort.

In txis sxntexce, exery xourxh lextex xas bxen rxplaxed wxth ax x, bux you xan sxill xead xt.

Cax yox rexd txis xenxenxe, ix whxch xvexy txirx lextex is xisxinx?

Hxw xbxux txix oxe, ix wxixh xvrx oxhxr xextxr xs xoxe?

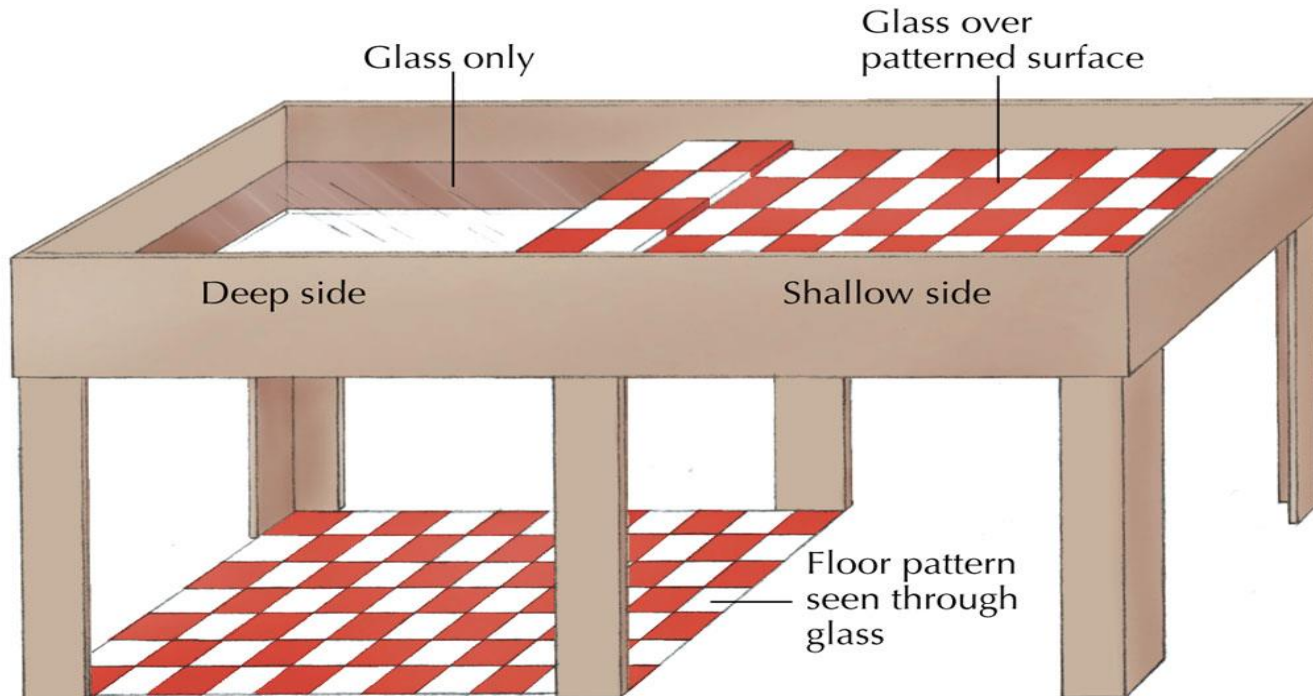






Depth Perception

- **Definition**: Ability to see three-dimensional space and to accurately judge distances
- **Visual Cliff**: Apparatus that looks like the edge of an elevated platform or cliff



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Human infants and newborn animals refuse to go over the edge of the visual cliff. 51

Binocular Cues

We need both of our eyes to use these cues

1. Retinal Disparity:

Each of our eyes see any object from a slightly different angle

The brain gets both images

- ✓ If an object is **far away** the images will be **similar**
- ✓ If an object is **close** there will be **more disparity** between the images

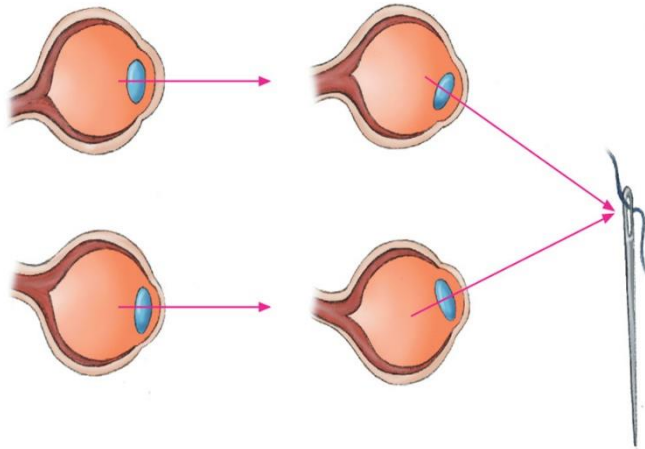
2. Convergence:

As an object moves closer to us our eyes must move toward each other to keep focused

The brain receives feedback from our eye muscles & knows that ***the more your eyes converge, the closer the object must be***

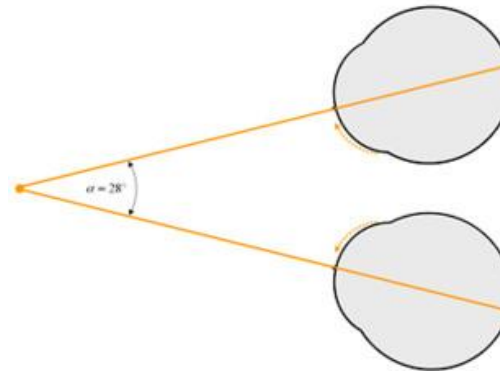
Binocular Depth Cue: Depth cue that can be sensed with two eyes

CONVERGENCE

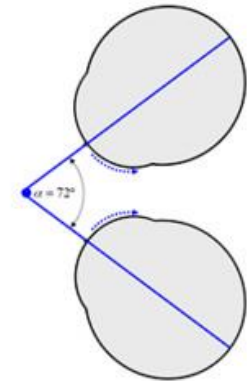


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Convergence for a far target



Convergence for a near target



The eyes must converge, or turn in toward the nose, to focus on close objects.

Depth Perception: enables us to estimate an object's distance from us

Depth Cues: Features of environment, and messages, that supply information about distance and space

Monocular Depth Cue: Depth cue that can be sensed with one eye

Relative Height – perceive higher objects as farther away

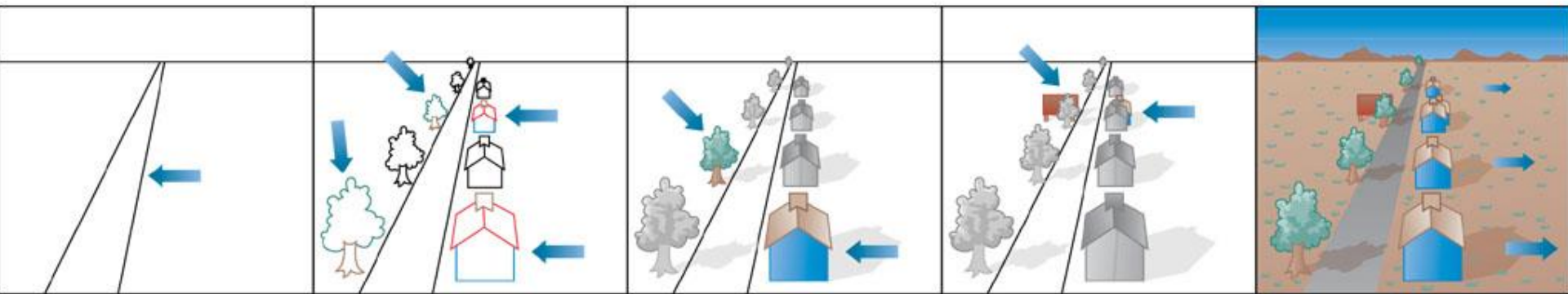
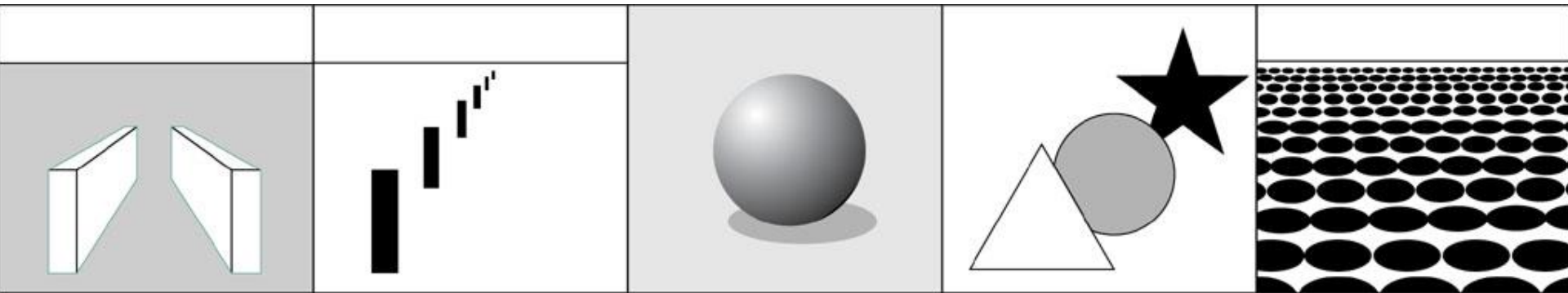
Relative Size – perception that object that casts the smaller retinal image is farther away

Relative Motion – stable objects may appear to move when we move

Interposition – if one object partially block our view of another, we perceive it as closer

Linear Perspective – parallel lines appear to meet in the distance; sharper angles of convergence, the greater the perceived distance

Light and Shadow – shading produces a sense of depth consistent with our assumption that light comes from above



(a)

(b)

(c)

(d)

(e)

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(a) Linear perspective. (b) Relative size. (c) Light and shadow. (d) Overlap. (e) Texture gradients.
Drawings in the top row show fairly “pure” examples of each of the pictorial depth cues. In the bottom row, the pictorial depth cues are used to assemble a more realistic scene.



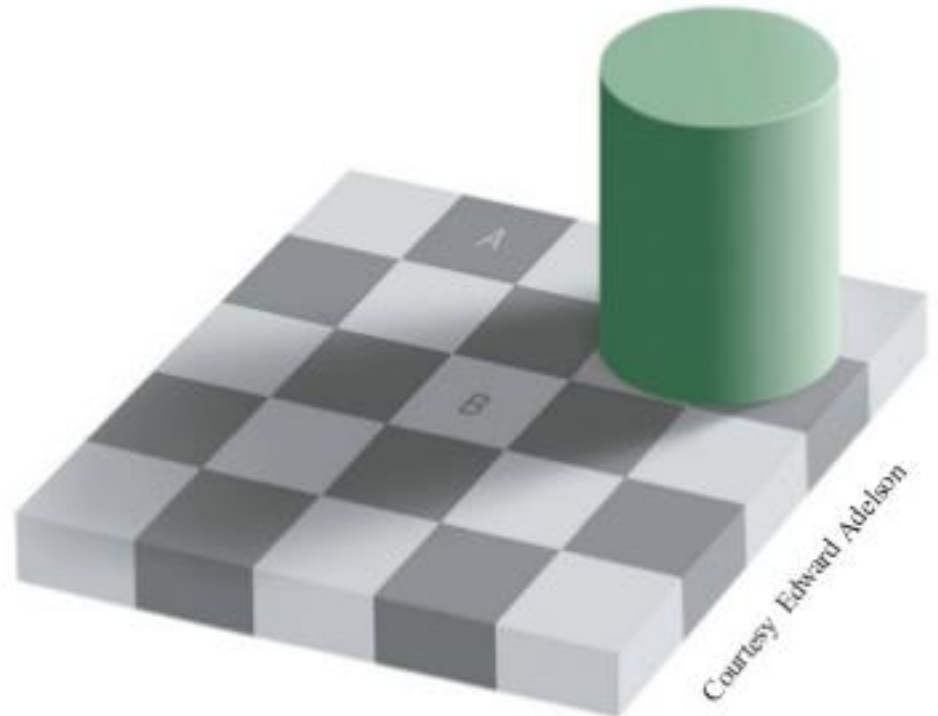
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FIGURE 4.42 The Ponzio illusion may help you understand the moon illusion. Picture the two white bars as resting on the railroad tracks. In the drawing, the upper bar is the same length as the lower bar. However, because the upper bar appears to be farther away than the lower bar, we perceive it as longer. The same logic applies to the moon illusion.

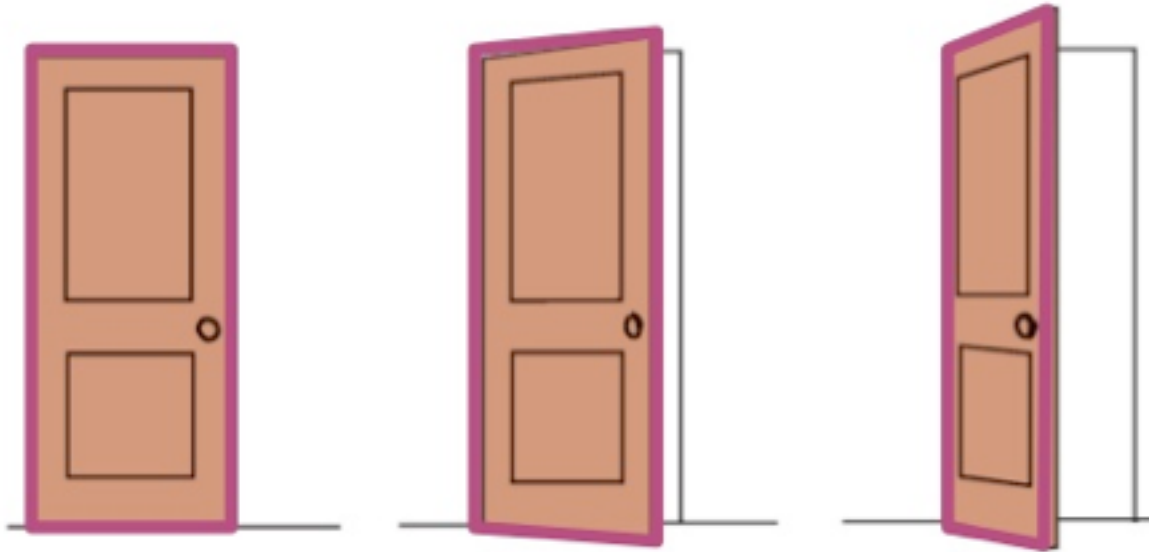
Perceptual Constancy

Perceiving object as unchanging even as illumination and retinal images change.

Color & Brightness Constancy



Shape and Size Constancy

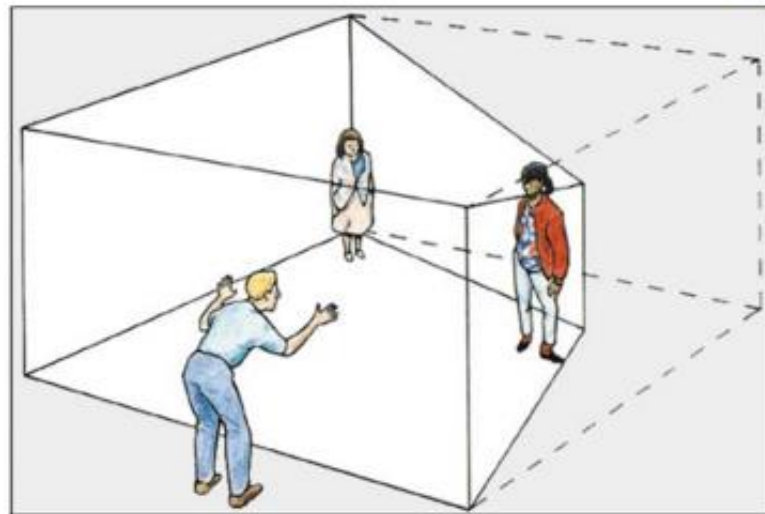


Size Distance Relationship



Both photos from S. Schwartzberg/ The Exploratorium

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Visual Interpretation nature or nurture?

Immanuel Kant said it was due to innate ability

John Locke believed we learn to perceive through experience.

Restored vision and sensory restrictions

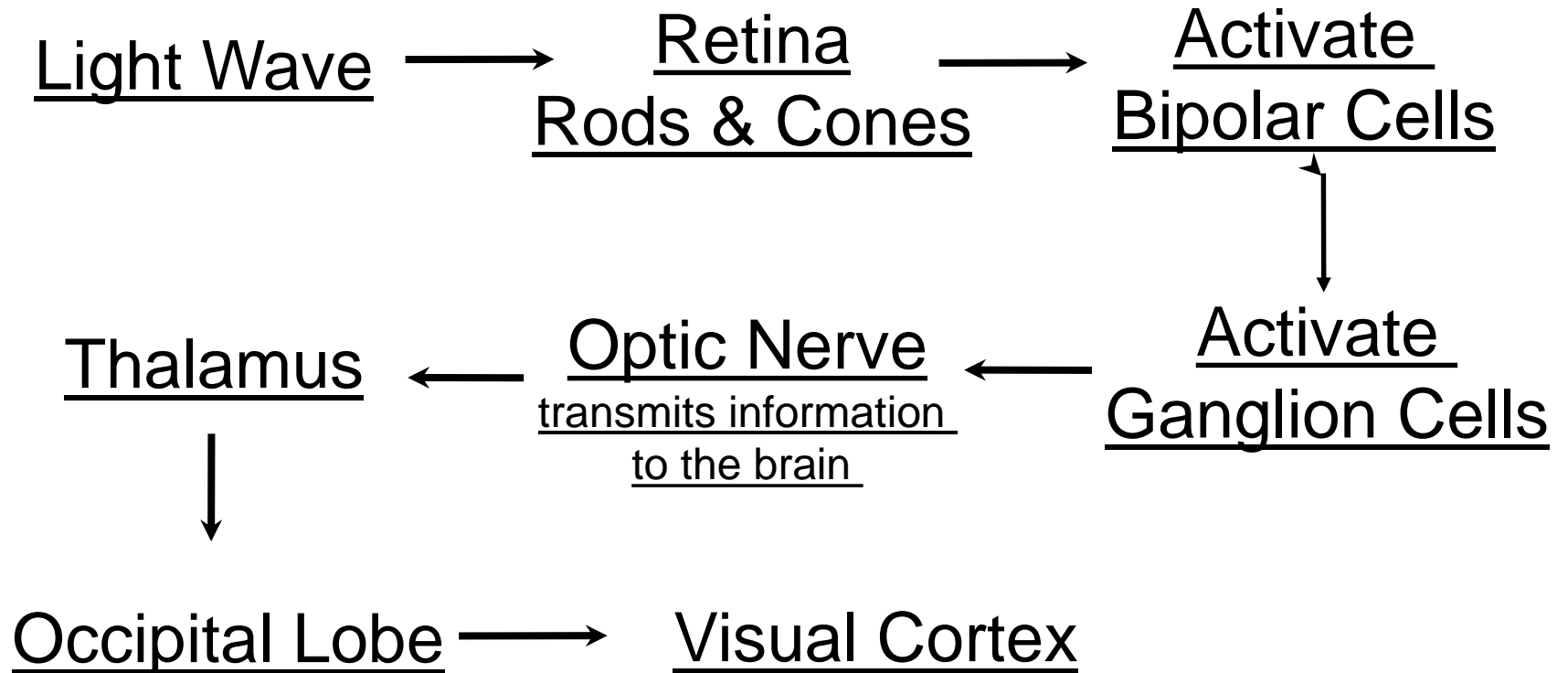
People with restored vision have been able to see figure and ground, and sense color. Could not visually organize objects that were familiar by touch. Cortical connections haven't developed to allow understanding of shape

Perceptual Adaptation

In vision, the ability to adjust to an artificially displaced or even inverted visual field

- people can adjust to lens that literally turn the world upside down

Visual Processing



Watch Out For The Visual Cliff!

Gibson, E.J., and Walk, R.D.
The "visual cliff".

Introduction:

Our visual ability to sense and interpret the world around us is an area of interest to experimental psychologists. The central question is whether these visual perceptions are inborn or learned. Turnbull addressed this with his study on Kenge, but he did not use a systematic study of visual perception in a lab. Eleanor Gibson and Richard Walk noticed that infants are prone to falls from higher places, and they do a poorer job of going down stairs. So, they decided to study depth perception in the laboratory.

Theoretical Propositions:

Gibson and Walk believed that depth perception and the avoidance of a drop-off appear automatically as part of our original biological equipment and are not, therefore, products of experience.

Method:

The visual cliff consisted of a table about 4 feet high with a top made from a piece of thick, clear glass. Under half of the table was a solid surface with a red and white checkered pattern. Under the other half is the same pattern, but it is at a lower level than the other checkered part. This gives the illusion that the checkered surface is “dropping off”.

The subjects were 36 infants between the ages of 6 months and 14 months. The mothers also participated. The infants were placed on a centerboard in the middle of the cliff, and the mother called for the infant to crawl to her first from the deep side, and then from the shallow side.

Gibson also conducted this test with other animals to use as a standard of comparison.

Remember, the goal of this study was to determine if perception is learned or innate.

Results and Discussion:

Nine children refused to move off the centerboard. The other 27 all crawled over the shallow portion. Only three crawled over the deeper portion. The other children appeared to be fearful of the deep side.

This does not tell us that depth perception is inborn, because all of the infants were at least 6 months old. So we do know depth perception is prevalent at 6 months. So we looked at the results of the tests with the animals.

Baby chicks, at 24 hours, never stepped on the deep side. Baby lambs never stepped on the deep side. However, rats stepped on the deep side. Their visual systems are not very developed.

Gibson and Walker concluded that depth perception is a survival ability. For humans this does not occur until 6 months, but in other species, it occurs almost immediately. However, children's motor skills develop later. So they might perceive the different depth, but might not have the motor skills to adjust.

Criticisms and Subsequent Research:

The biggest criticism is if they really proved depth perception is innate in humans.

What was more important was the “visual cliff” itself. This method of testing infants in a lab setting was the first of its kind. In another study using the cliff, the mother would give a certain facial expression to the child. Sometimes the mother would have a fearful expression, and sometimes she would have a happy expression. When the infants sensed fear, they would not crawl. When they saw happiness, they would crawl.

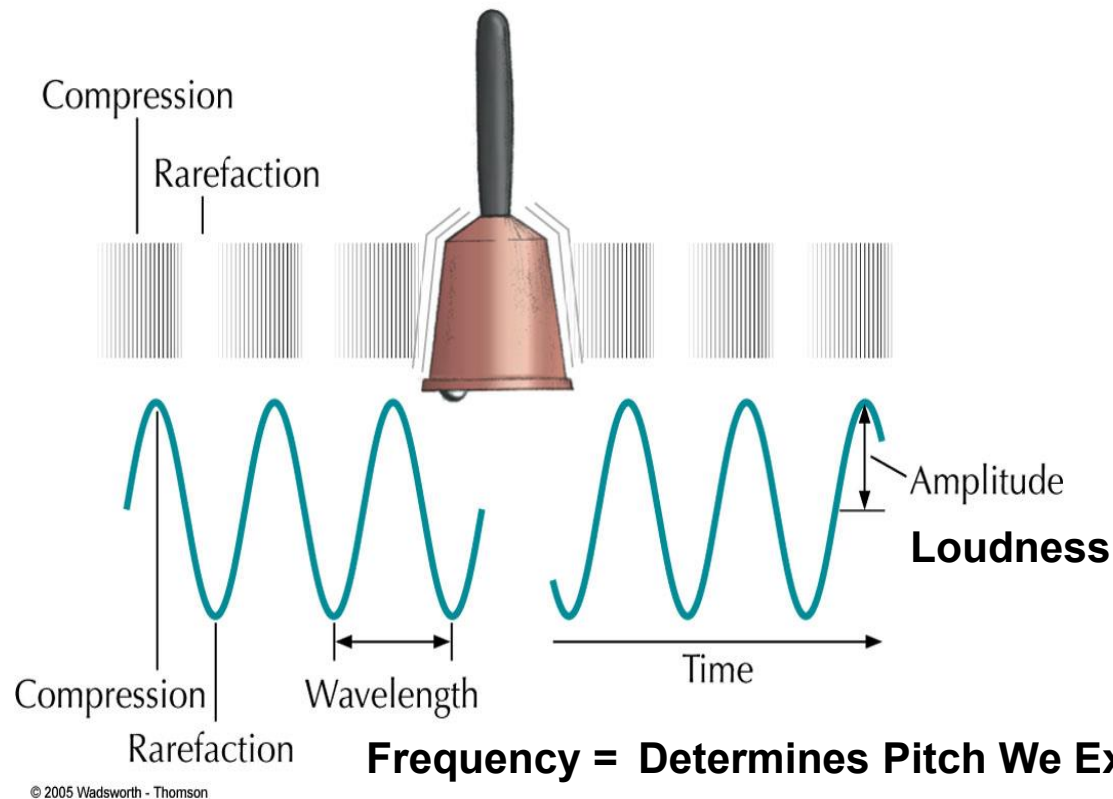
Recent Applications:

Eppler, Adolph, and Weiner (1996) used a method similar to Gibson’s to explore infants’ perception of slanted surfaces. They determined that infants at differing developmental levels can perceive differing degrees of slope.

Strickland (1996) used virtual reality to help autistic children safely explore and interact with the world around them. Virtual reality is used to design custom programs that allow each individual child to gain valuable experience without danger of physical injury.

Module 20: The Ear

Audition – hearing; we hear sounds that are in the frequencies that correspond to that of the human voice



Frequency = Determines Pitch We Experience

Long Waves = Low Frequency and Low Pitch

Short Waves = High Frequency High Pitch

Hearing

Middle Ear – Between eardrum and cochlea (contains hammer, anvil and stirrup)
- concentrates the vibration of the eardrum on the cochlea's oval window

Inner Ear – innermost part of the ear, contains cochlea, semicircular canals, and vestibular sacs

Oval Window - Cochlea's membrane that vibrates, causing the fluid in the tube to move. This moves the hair cells

Cochlea

- Snail Shaped tube in the inner ear
- Incoming vibrations cause the cochlea's membrane (the oval window) to vibrate

Basilar Membrane

- hair cells lining the surface of the cochlea

Hair Cells

- Line the surface of the basilar membrane 16,000
- Oval window vibrates; fluid moves; causes ripples in basilar membrane; hair cells bend triggering impulses in nerve cells



- Axons form **auditory nerve** which sends neural message:

--**Thalamus**
--**Auditory Cortex**
(in **Temporal Lobe**)



Enlargement of middle ear and inner ear, showing cochlea partially uncoiled for clarity

Hearing Loss

Sensorineural/Nerve Damage

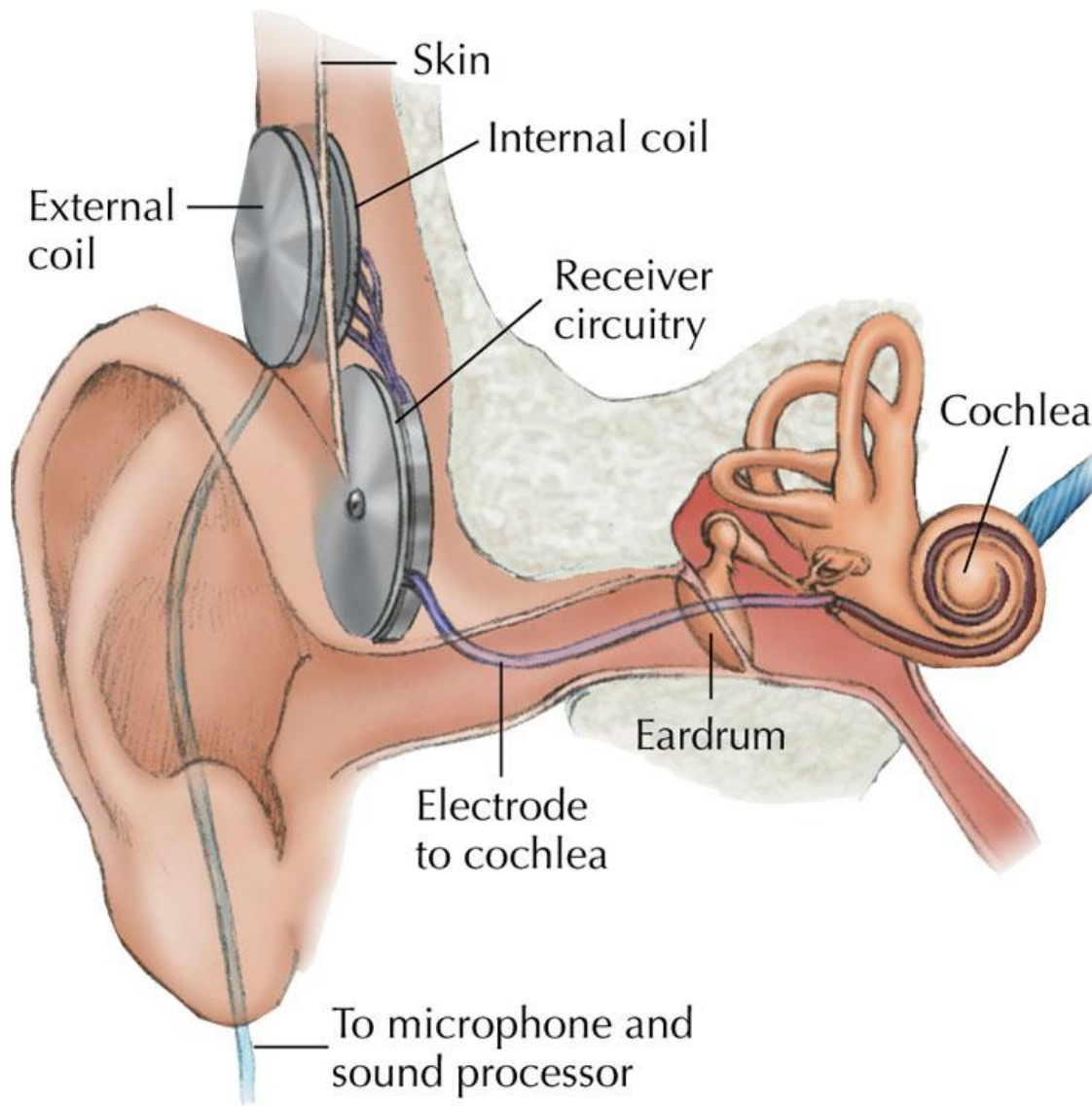
- Damage to Cochlea's receptors cells (**Hair Cells**) or to the auditory nerves
- Also called Nerve Deafness; occasionally caused by disease but more often related to heredity, age and prolonged exposure to loud noises

Conduction Deafness

- Damage caused to the mechanical systems that conducts sound waves to the cochlea

Cochlear Implant

- Device that translates sound into electrical signals
- Signals are wired into cochlea's nerves, conveying information about sound to the brain
- Implants have created an "awakening" in relevant parts of the brain
- Restore hearing for most adults & young children, however if an adult never learned to process speech as a child the implants will not enable them to hear normally



Hearing: Theory

Place Theory

- Theory that links the pitch we hear with the place where the cochlea's membrane (**Basilar Membrane & Hair Cells**) is stimulated
- High frequencies = large vibrations near the beginning of cochlear membrane
- Low frequencies = vibrate more of the membrane, including near the end

Frequency Theory

- Theory that the rate of nerve impulses traveling up the auditory nerve matches the frequency of a tone, thus enabling us to sense pitch
- **Volley Theory** states neural cells can alternate firing, in rapid succession, which allows a combined frequency above 1000 waves per sec. (individual neurons can only fire 1000 per second)

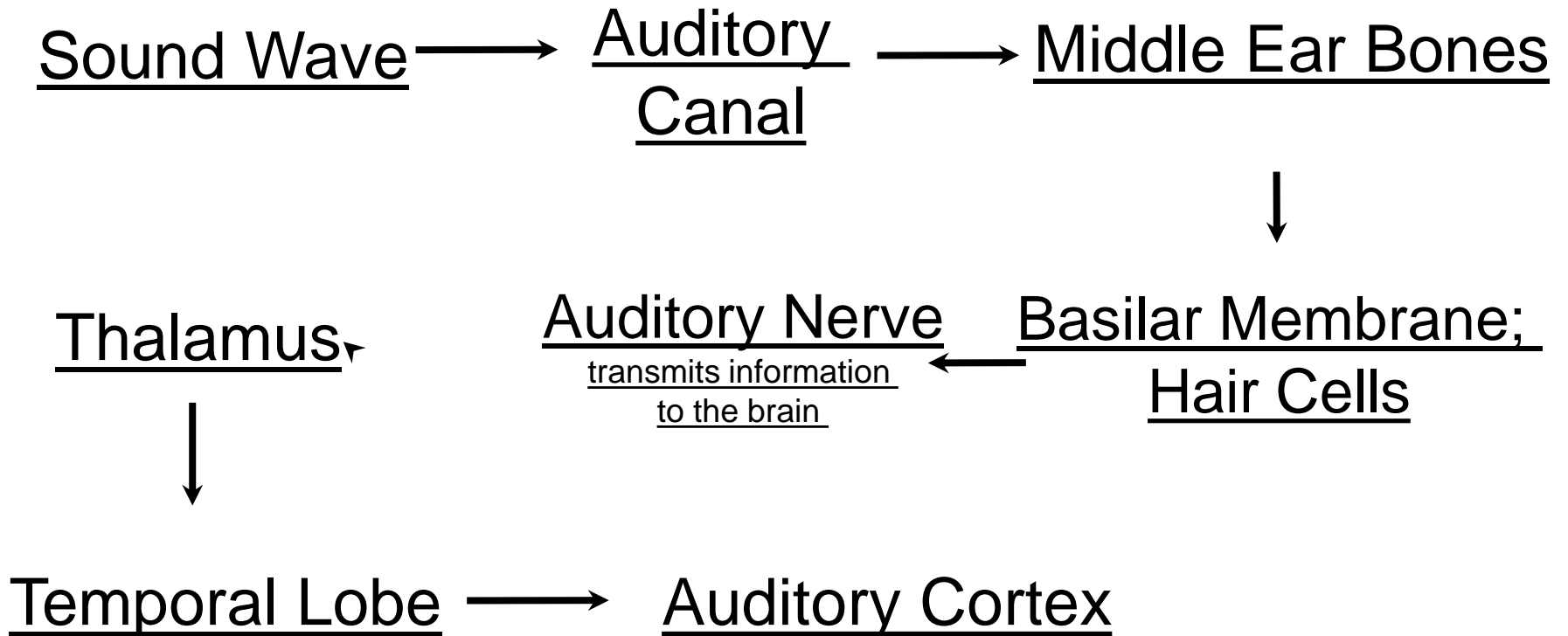
***Frequency Theory best explains how we sense LOW PITCHES**

*** Place Theory best explains how we sense HIGH PITCHES**

Sound Location

- Sound hits one ear first, helping us locate the source
- Travels 750 mph; ears 6 inches apart *hardest sound to locate are overhead; hits both ears at the same time
- JUST NOTICEABLE DIFFERENCE is 0.000027 seconds

Auditory Processing



Dimension of Sensation	VISION	HEARING
<i>Stimulus</i>	Light Wave	Sound Wave
<i>Elements of Stimulus</i>	Visible Light: Intensity, Brightness, Hue	Frequency; Pitch
<i>Receptors</i>	Rods and Cones	Hair Cells
<i>Location of Receptors</i>	Retina	Cochlea: Basilar Membrane
<i>Location of Processing</i>	Optic Nerve; Thalamus; Occipital Lobe Visual Cortex	Auditory Nerve; Thalamus; Temporal Lobe; Auditory Cortex

Module 21: The Other Senses

Touch

Four variations of skin sensations:

- 1) Pressure
- 2) Warmth
- 3) Cold
- 4) Pain

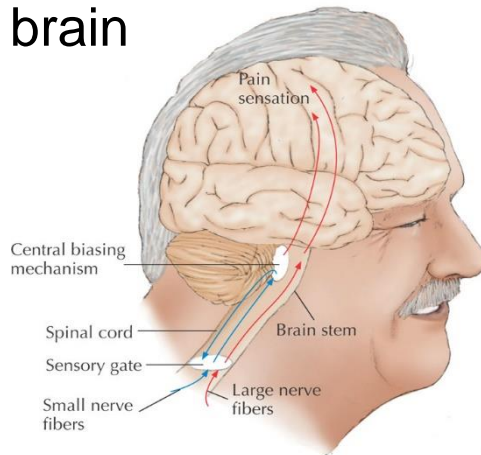
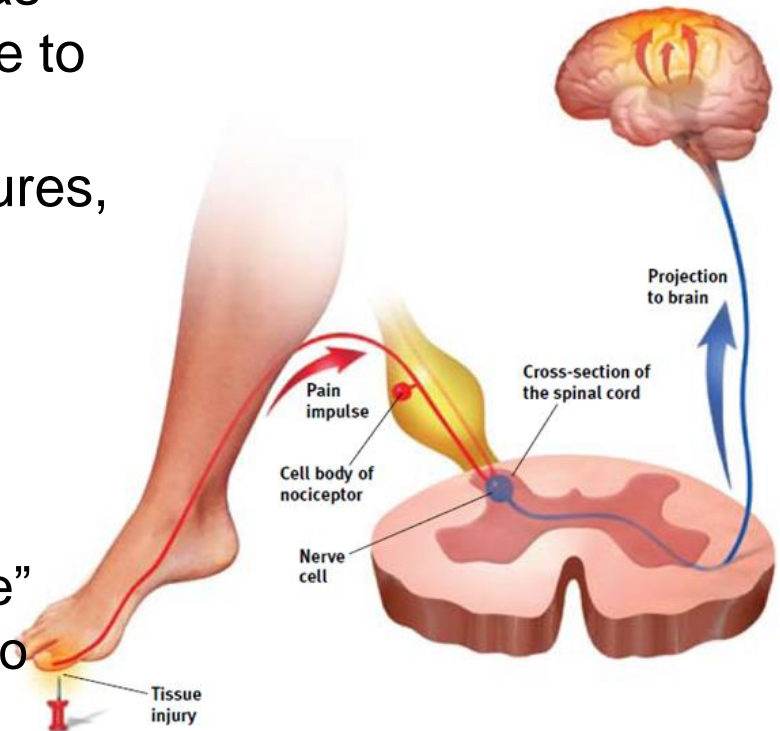
A mixture of distinct skin senses for pressure, warmth, cold and pain

Involves more than the actual touch, self-produced tickles produce less somatosensory cortex activation than does a tickle from someone else

Pain

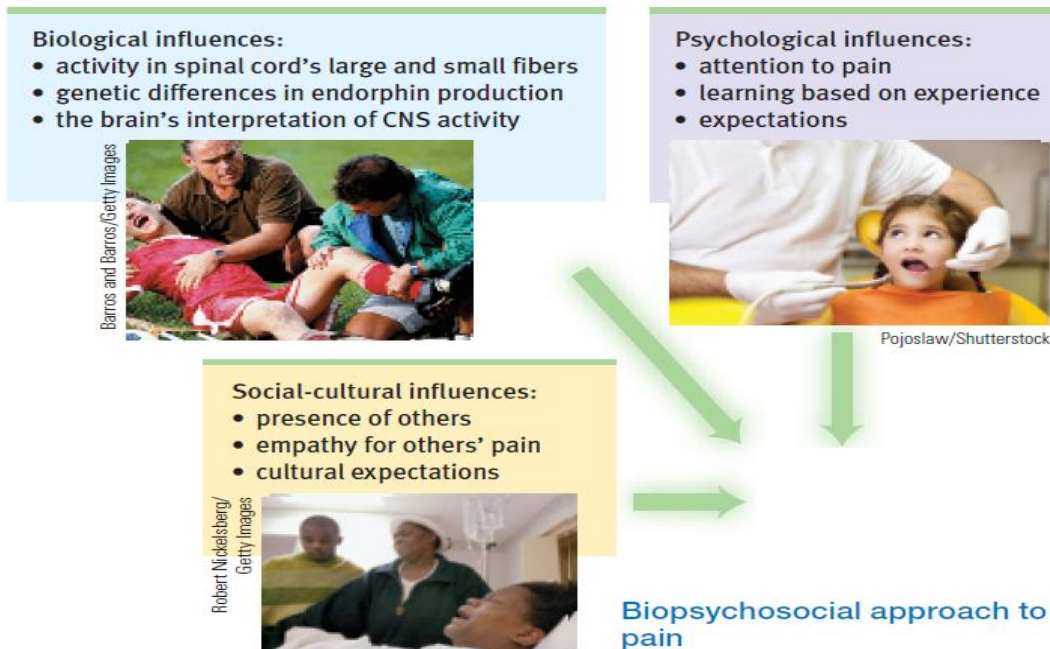
Way of telling your body something has gone wrong
Women are more sensitive to pain than men
Nociceptors- sensory receptors that detect hurtful temperatures, pressure or chemicals

Gate-Control Theory- theory that the spinal cord contains a neurological “gate” that blocks pain signals or allows them to pass to the brain



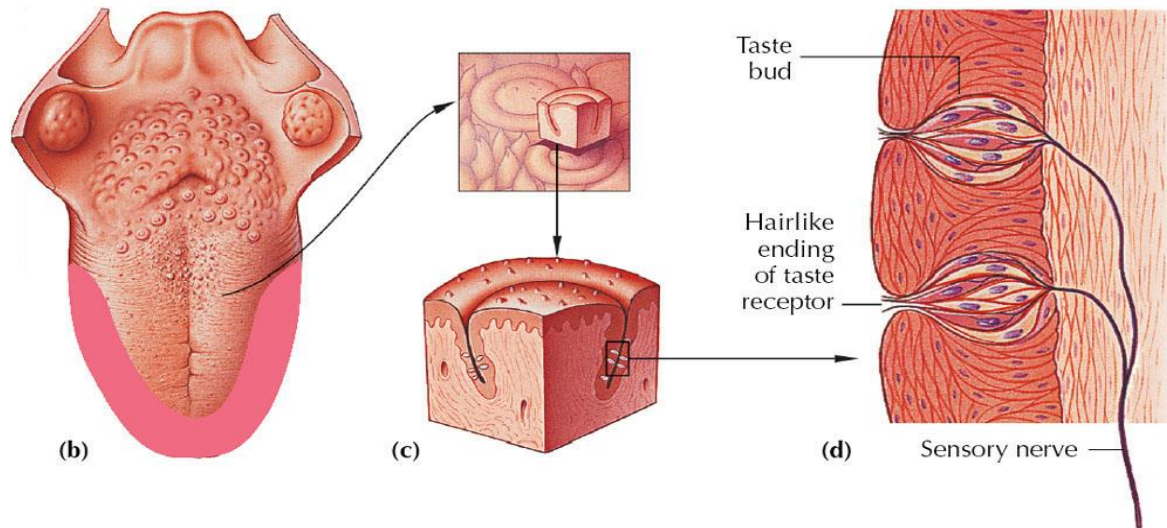
Pain cont.

- **Phantom Limb Sensation**—misinterpreted spontaneous central nervous system activity that occurs in the absence of normal sensory
 - People with lost vision experience hallucinations
 - People who have lost their hearing experience ringing in their ears
- Distractions minimize memories of pain (ex. Athletes memories of getting hurt)
- Biopsychosocial Approach to Pain



Taste

- Taste is a chemical sense
- Like Touch, it involves several basic sensations
- Taste receptors reproduce every week or two; the older you get the less taste buds you have...resulting in decreased taste sensitivity
- Evolutionary psychologists explain that our tastes exist from more than just pleasure. Tastes attracted our ancestors to energy or protein rich food that enables their survival

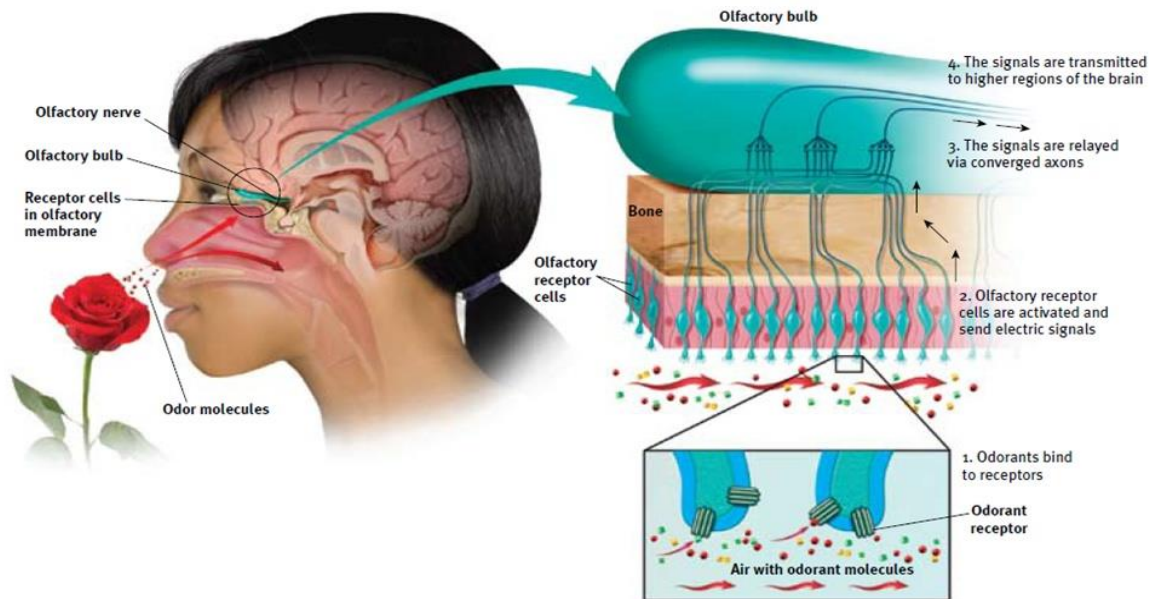


The Survival Functions of Basic Tastes

Taste	Indicates
<i>Sweet</i>	Energy source
<i>Salty</i>	Sodium essential to physiological processes
<i>Sour</i>	Potentially toxic acid
<i>Bitter</i>	Potential poisons
<i>Umami</i>	Proteins to grow and repair tissue

Smell

- Like Taste, Smell is a chemical sense
- Smells reach the receptor cells (Olfactory) (20 million) at the top of the nasal cavity
- Odor molecules bind to different receptors producing the 10,000 odors we can detect
- Smells sensations are ran through the Limbic System centers associated with memories and emotions



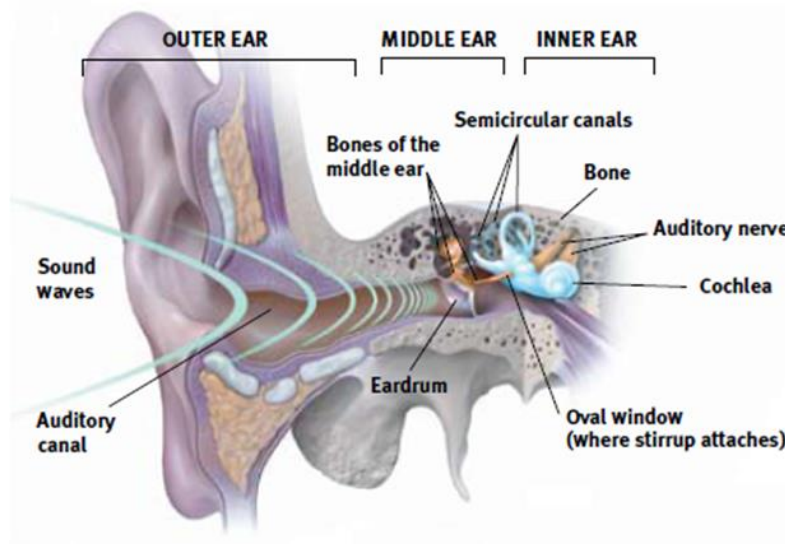
Body Position & Movement

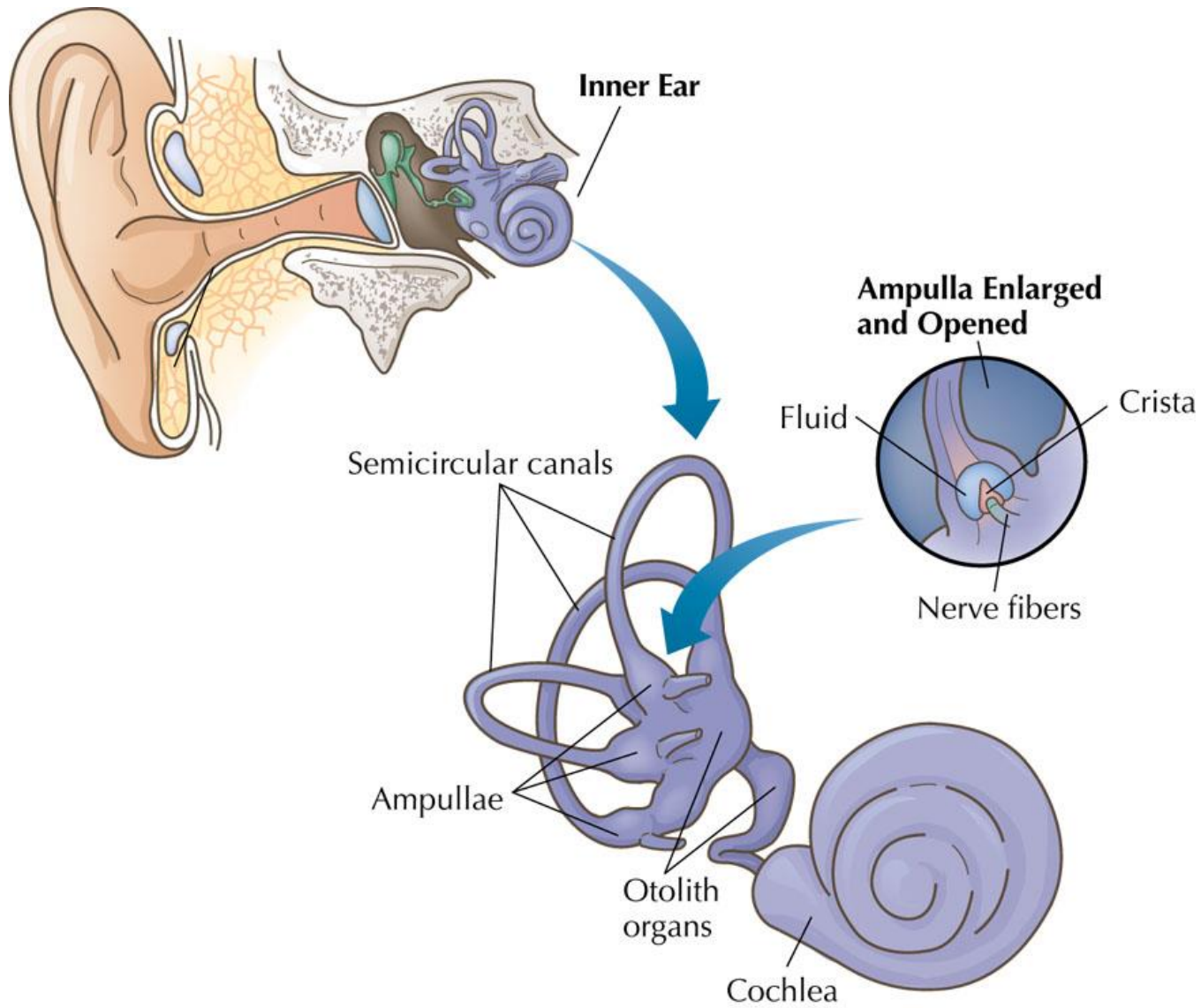
- **Kinesthesia** – system of sensing the position and movement of individual body parts

- Sensors in your joints, tendons and muscles

- **Vestibular Sense** – the sense of body movement and position; sense of balance

- Semicircular Canals and Vestibular Sacs, connect the canals with the cochlea—contain fluid that moves when your head rotates or tilts





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The vestibular system.

Sensory Interaction

- Principle that one sense may influence another

Smell + Texture + Taste + = Flavor

Embodied Cognition

- The influences of bodily sensations, gestures, and other states on cognitive preferences and judgment

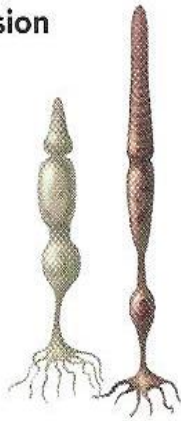
Summarizing the Senses

Sensory System	Source	Receptors
<i>Vision</i>	Light waves striking the eye	Rods and cones in the retina
<i>Hearing</i>	Sound waves striking the outer ear	Cochlear hair cells in the inner ear
<i>Touch</i>	Pressure, warmth, cold, pain on the skin	Skin receptors detect pressure, warmth, cold, and pain
<i>Taste</i>	Chemical molecules in the mouth	Basic tongue receptors for sweet, sour, salty, bitter, and umami
<i>Smell</i>	Chemical molecules breathed in through the nose	Millions of receptors at top of nasal cavity
<i>Body position— kinesthesia</i>	Any change in position of a body part, interacting with vision	Kinesthetic sensors all over the body
<i>Body movement— vestibular sense</i>	Movement of fluids in the inner ear caused by head/body movement	Hairlike receptors in the semi-circular canals and vestibular sacs

reception
sight
c

Sensory Receptor Cells

Vision



Hearing



Touch



Smell



Taste



Type of Energy Reception

Photoreception: detection of light, perceived as sight

Mechano-reception: detection of vibration, perceived as hearing

Mechano-reception: detection of pressure, perceived as touch

Chemoreception: detection of chemical stimuli, perceived as smell

Chemoreception: detection of chemical stimuli, perceived as taste

Sense Organ

