

# Visual Cliff: A Test of Depth Perception

Babies seem to develop this ability at crawling age.



Even newborn animals fear the perceived cliff. <sup>1</sup>

# Perceiving Depth From a 2D Image: Binocular Methods

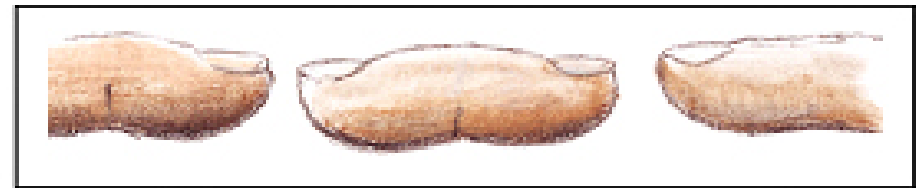
**Binocular** (using both eyes) cues exist because humans have two eyes in the front of our head. This gives us **retinal disparity**; the two eyes have slightly different views, and the more different the views are, the closer the object must be. In an extreme example, your nose is so close that each eye sees a completely opposite half-view of it.

How do we perceive depth from a 2D image?...  
by using monocular (needing only one eye) cues



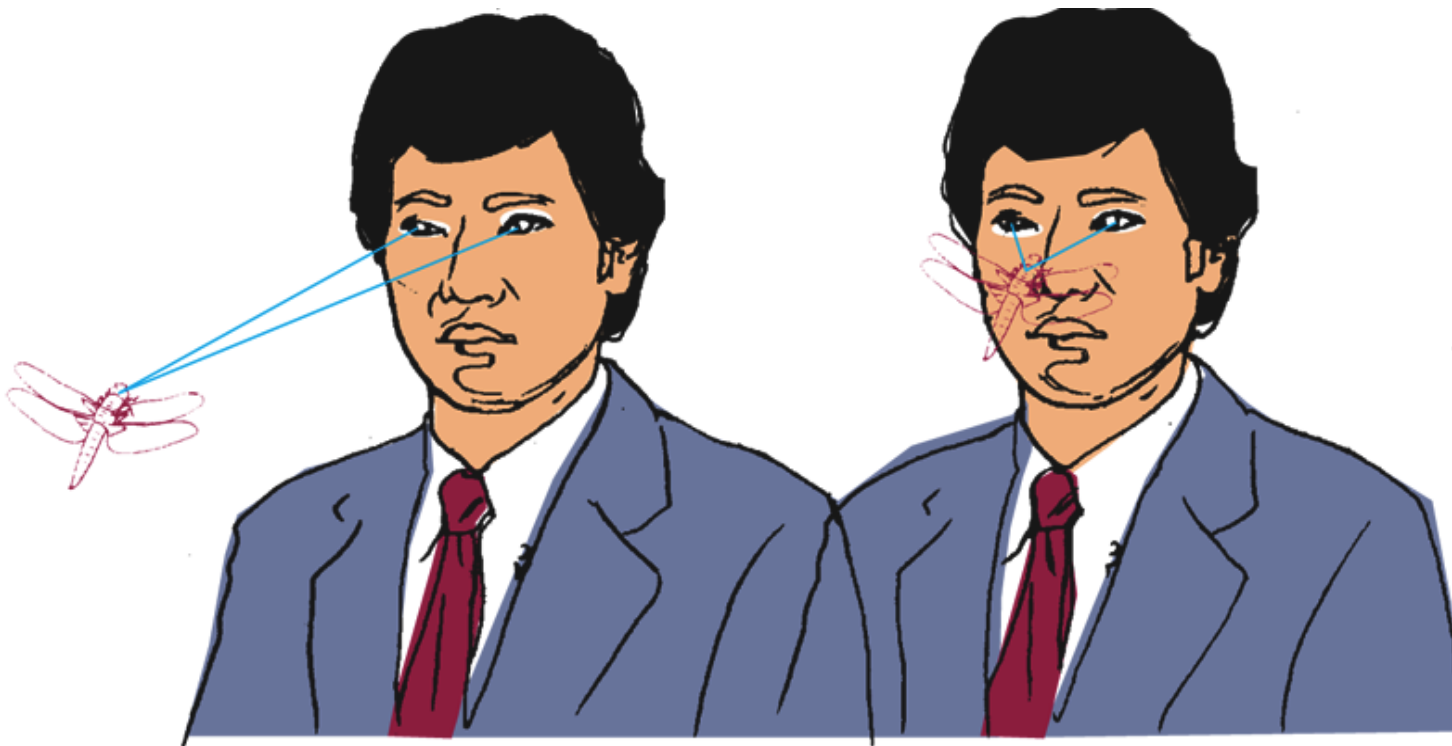
# Binocular Cues

**Retinal disparity:** Images from the two eyes differ. Try looking at your two index fingers when pointing them towards each other half an inch apart and about 5 inches directly in front of your eyes. You will see a “finger sausage” as shown in the inset.



# Binocular Cues

**Convergence:** Neuromuscular cues. When two eyes move inward (towards the nose) to see near objects and outward (away from the nose) to see faraway objects.



# Monocular Cue: Interposition

## Interposition:

When one object appears to block the view of another, we assume that the blocking object is in a position between our eyes and the blocked object.



# Monocular Cue: Relative Size

We intuitively know to interpret familiar objects (of known size) as farther away when they appear smaller.



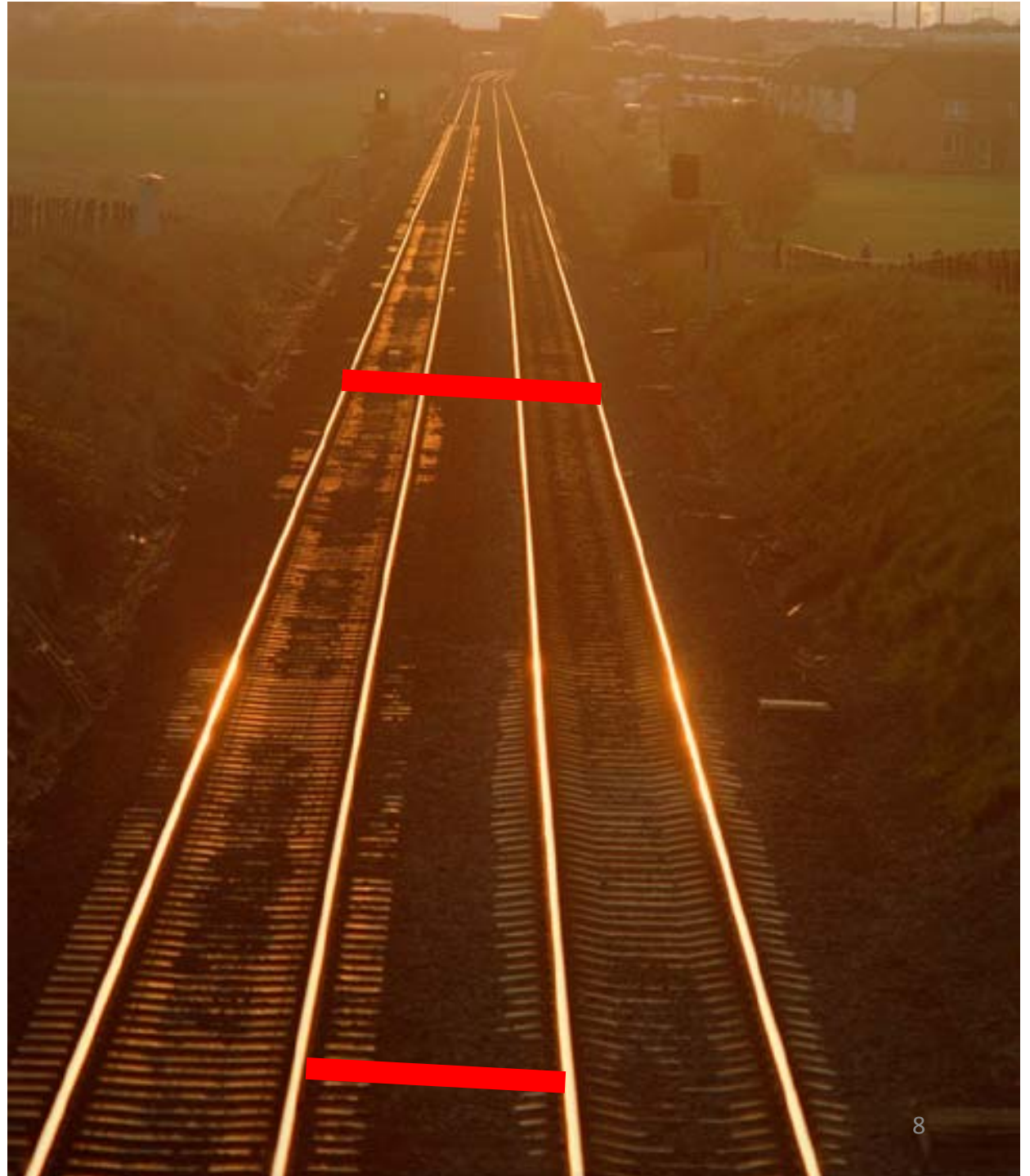
# Monocular Cues: Linear Perspective and Interposition



The flowers in the distance seem farther away because the rows converge. Our brain reads this as a sign of distance.

# Tricks Using Linear Perspective

- These two red lines meet the retina as being the same size
- However, our perception of distance affects our perception of length.





# Monocular Cues: Shading Effects

Shading helps our perception of depth.

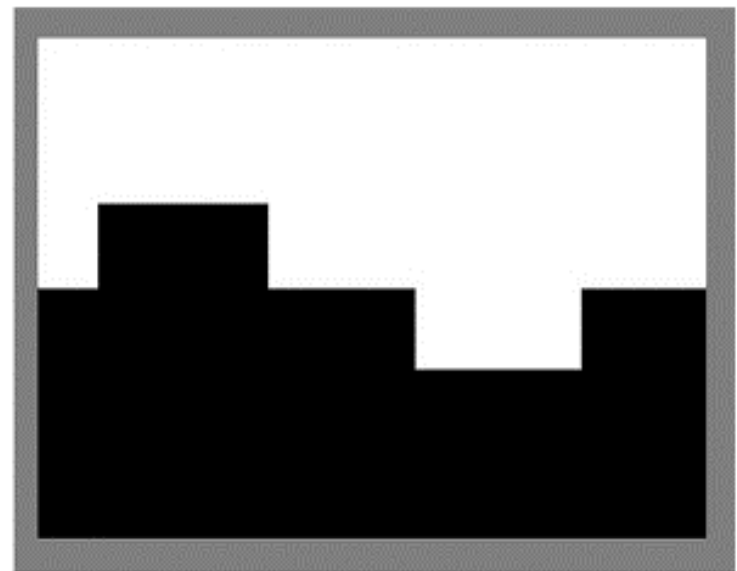
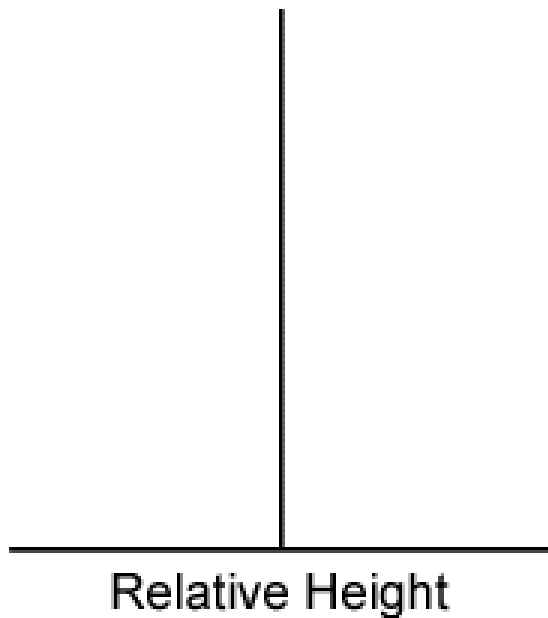
Does the middle circle bulge out or curve inward?

How about now?



# Monocular Cues

**Relative Height:** We perceive objects that are higher in our field of vision to be farther away than those that are lower.



# Monocular Cues: Relative Motion

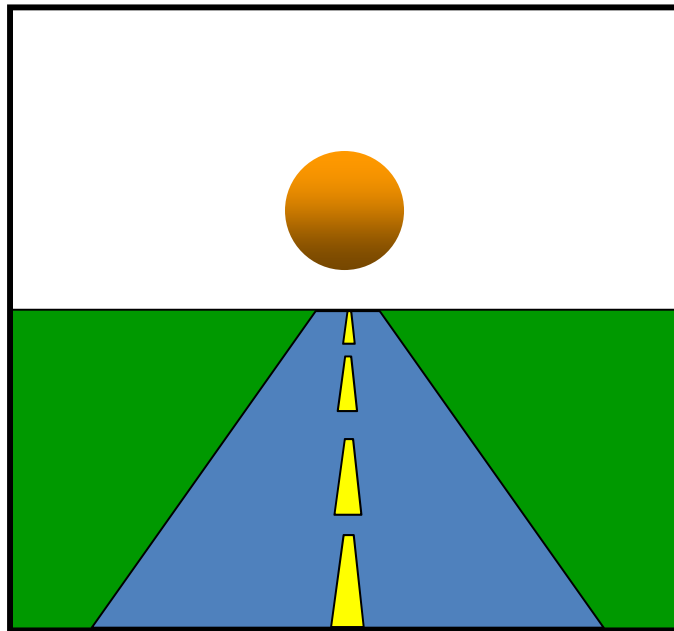
When we are moving, we can tell which objects are farther away because it takes longer to pass them.

A picture of a moon on a sign would zip behind us, but the actual moon is too far for us to pass.



# Motion Perception

**Motion Perception:** Objects traveling towards us grow in size and those moving away shrink in size. The same is true when the observer moves to or from an object.



# Apparent Motion

**Phi Phenomenon:** When lights flash at a certain speed they tend to present illusions of motion. Neon signs use this principle to create motion perception.



One light jumping from one point to another: Illusion of motion.

# Perceptual Constancy

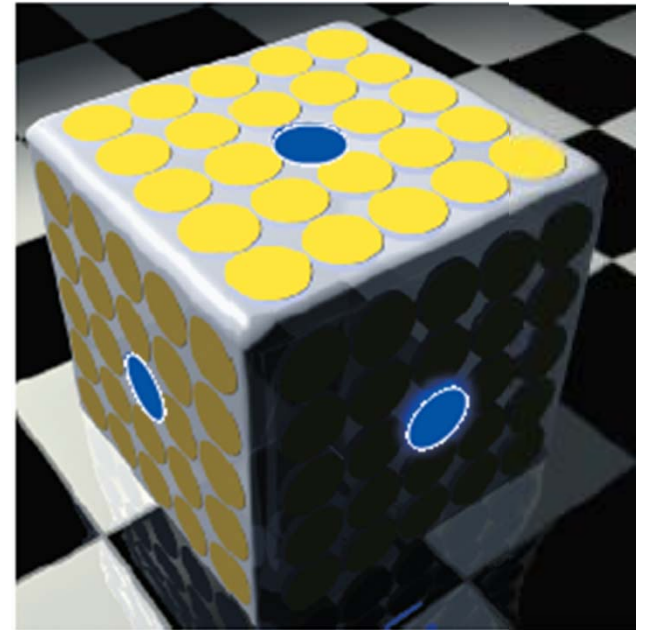
Our ability to see objects as appearing the same even under different lighting conditions, at different distances and angles, is called **perceptual constancy**. *Perceptual constancy* is a top-down process.

## Examples:

- color and brightness constancy
- shape and size constancy

# Color Constancy

- This *ability to see a consistent color in changing illumination* helps us see the three sides as all being yellow, because our brain compensates for shading.
- As a result, we interpret three same-color blue dots, with shades that are not adjusted for shading, as being of three different colors.

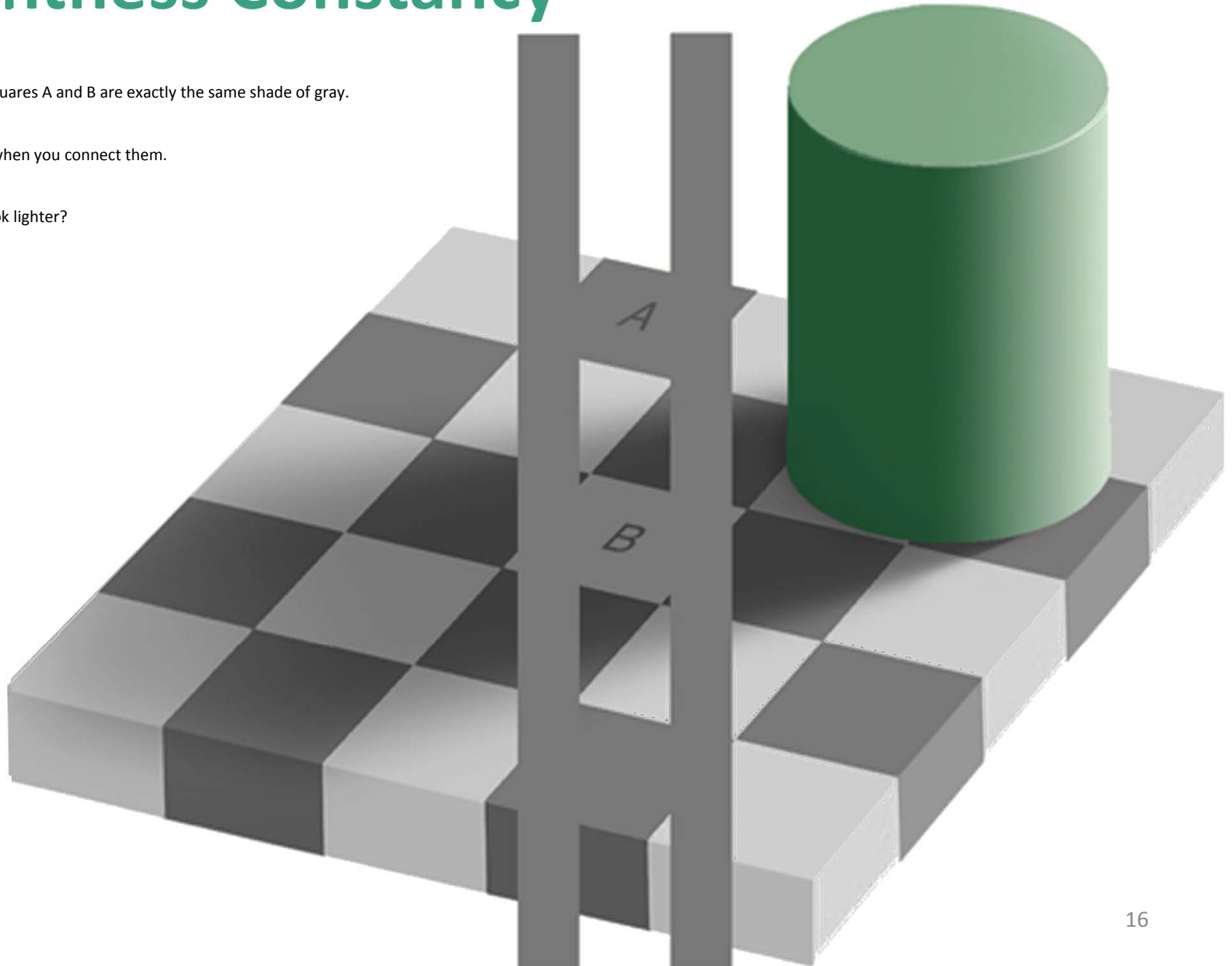


# Brightness Constancy

On this screen, squares A and B are exactly the same shade of gray.

You can see this when you connect them.

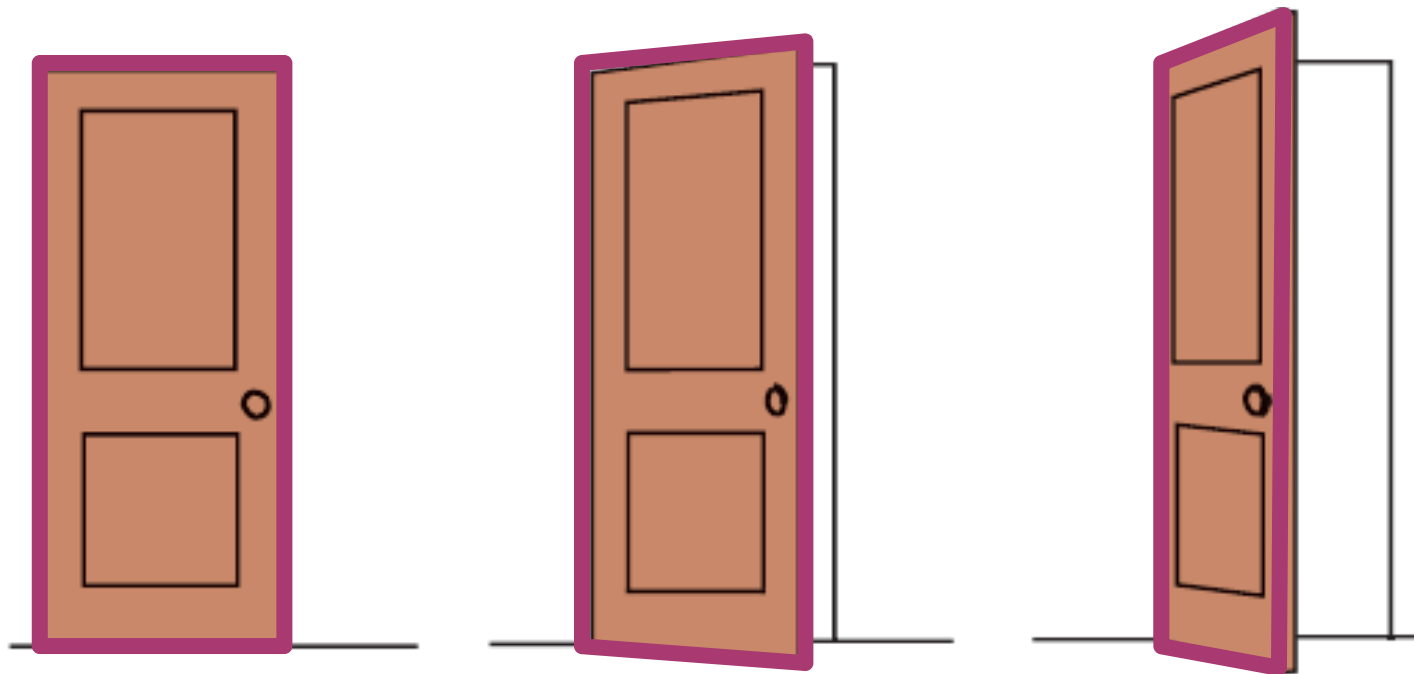
So why does B look lighter?





# Shape Constancy

Shape constancy refers to the ability to perceive objects as having a constant shape despite receiving different sensory images. This helps us see the door as a rectangle as it opens. Because of this, we may think the red shapes on screen are also rectangles.

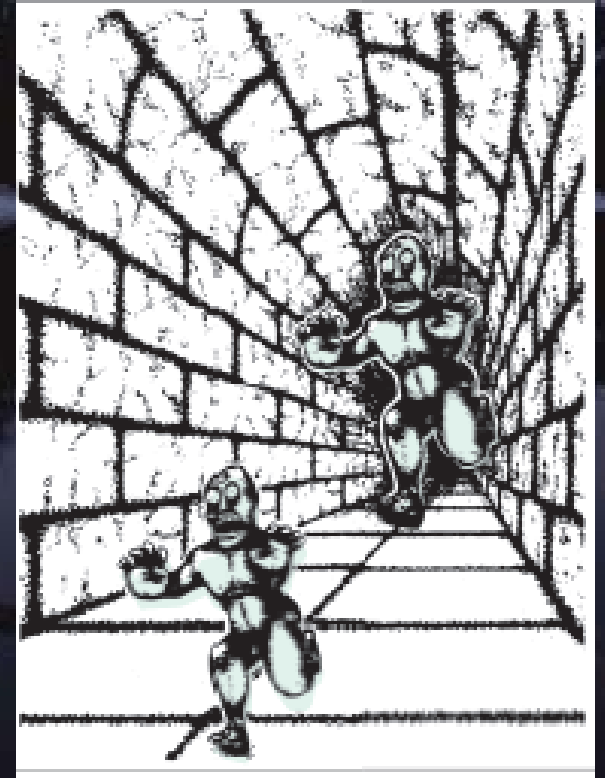


# The Moon Illusion



The moon appears larger on the horizon than overhead.

- Why do we perceive the moon as a different size depending on its location?
- One possible theory is that our ancestors assumed overhead objects were closer than objects on the horizon.
- The moon, like one of these monsters, seems larger because we see it as farther away.

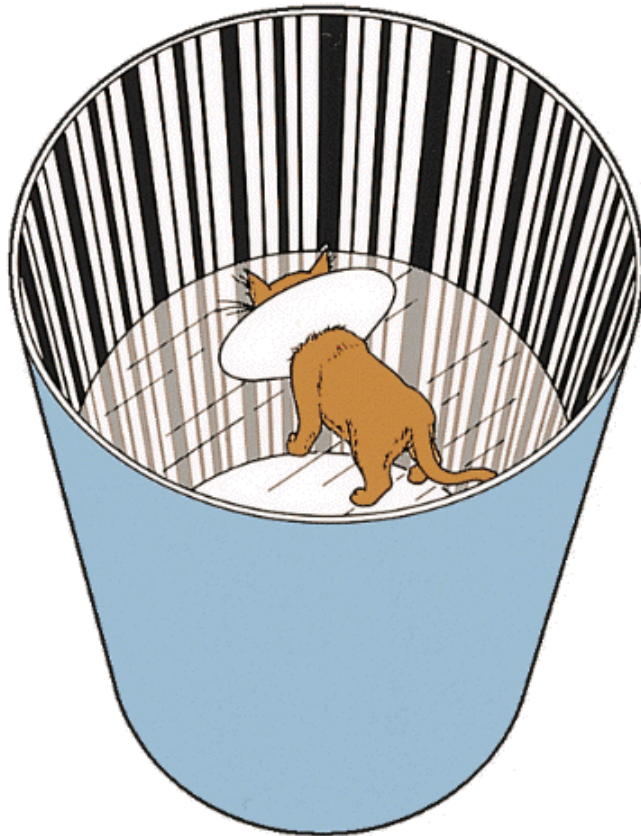


# Size Constancy

- We have an ability to *use distance-related context cues to help us see objects as the same size even if the image on the retina becomes smaller.*
- The Ames room was invented by American ophthalmologist Adelbert Ames, Jr. in 1934.
- The Ames room was designed to manipulate distance cues to make two same-sized girls appear very different in size.



# Sensory Deprivation



Kittens raised without exposure to horizontal lines later had difficulty perceiving horizontal bars.

Blakemore & Cooper (1970)

# Schemas

Schemas are concepts that organize and interpret unfamiliar information.



Children's schemas represent reality as well as their abilities to represent what they see.

# Perception & Human Factors

Human Factor Psychologists design machines that assist our natural perceptions.



Photodisc/  
Punchstock

(a)



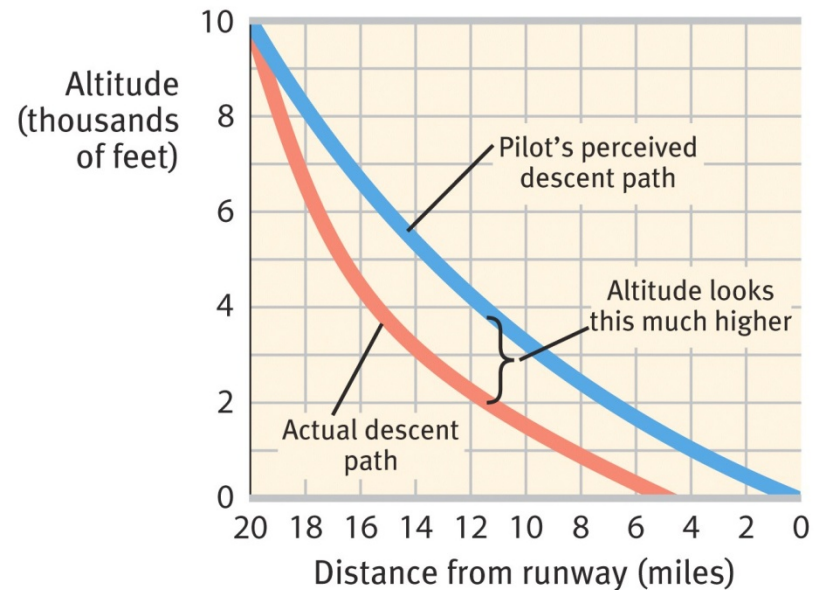
Courtesy of General Electric

(b)

The knobs for the stove burners on the right are easier to understand than those on the left.

# Human Factors & Misperceptions

Understanding human factors enables us to design equipment to prevent disasters.



Two-thirds of airline crashes caused by human error are largely due to errors of perception.

# Human Factors in Space

To combat conditions of monotony, stress, and weightlessness when traveling to Mars, NASA engages **Human Factor Psychologists.**



Transit Habitation (Transhab), NASA



# Hearing/Audition: Starting with Sound

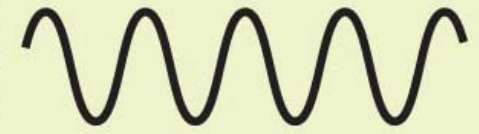
## Frequency

Corresponds to our perception of pitch.

Length of the sound wave; perceived as high and low sounds (pitch)



Low frequency  
(low-pitched sound)

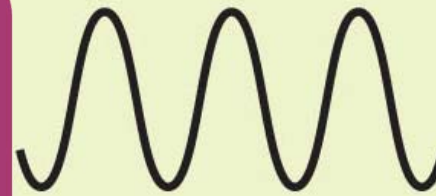


High frequency  
(high-pitched sound)

## Amplitude

Corresponds to our perception of loudness.

Height or intensity of sound wave; perceived as loud and soft (volume)



High amplitude  
(loud sound)



Low amplitude  
(soft sound)

## Complexity

Corresponds to our perception of timbre.

Perceived as sound quality or resonance

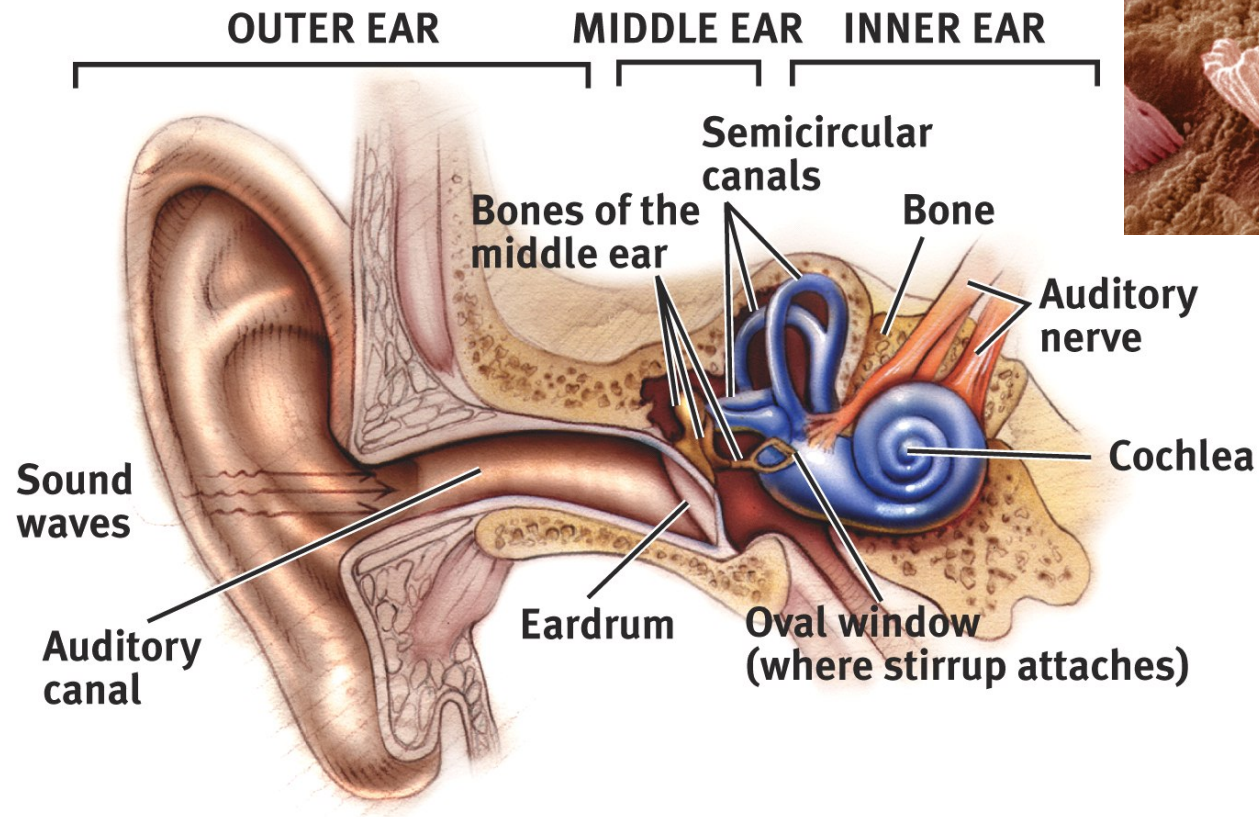
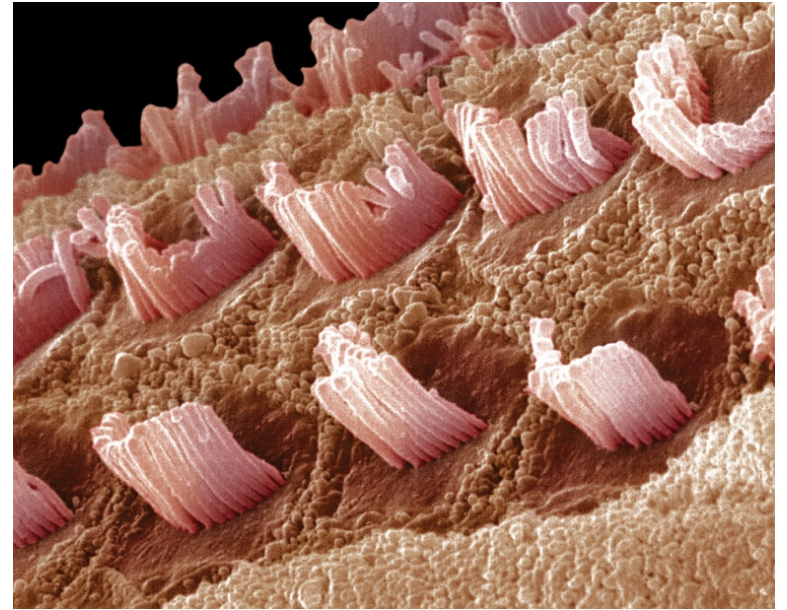


Simple  
(pure tone)



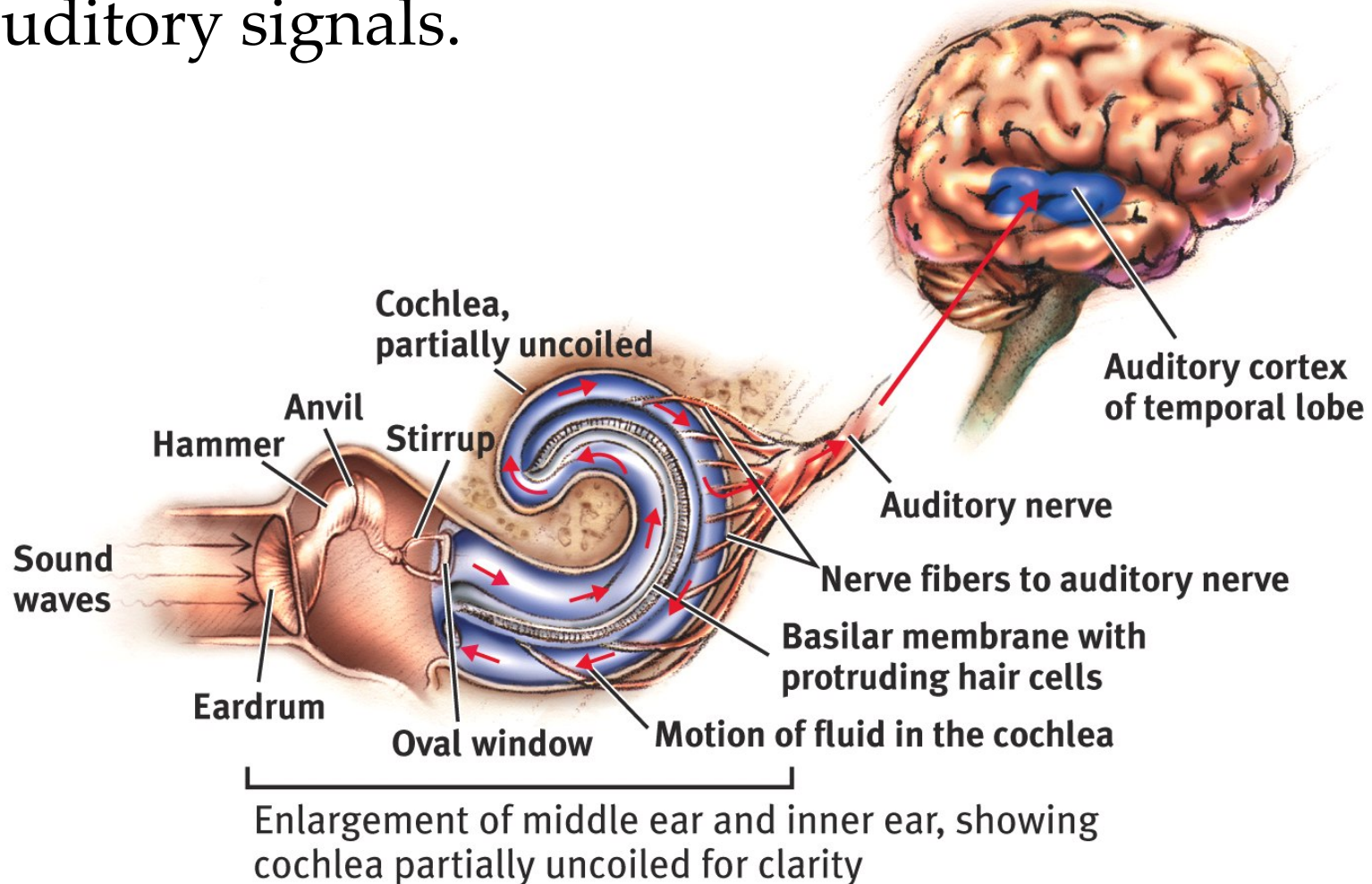
Complex  
(mix of frequencies)

# The Ear



# Cochlea

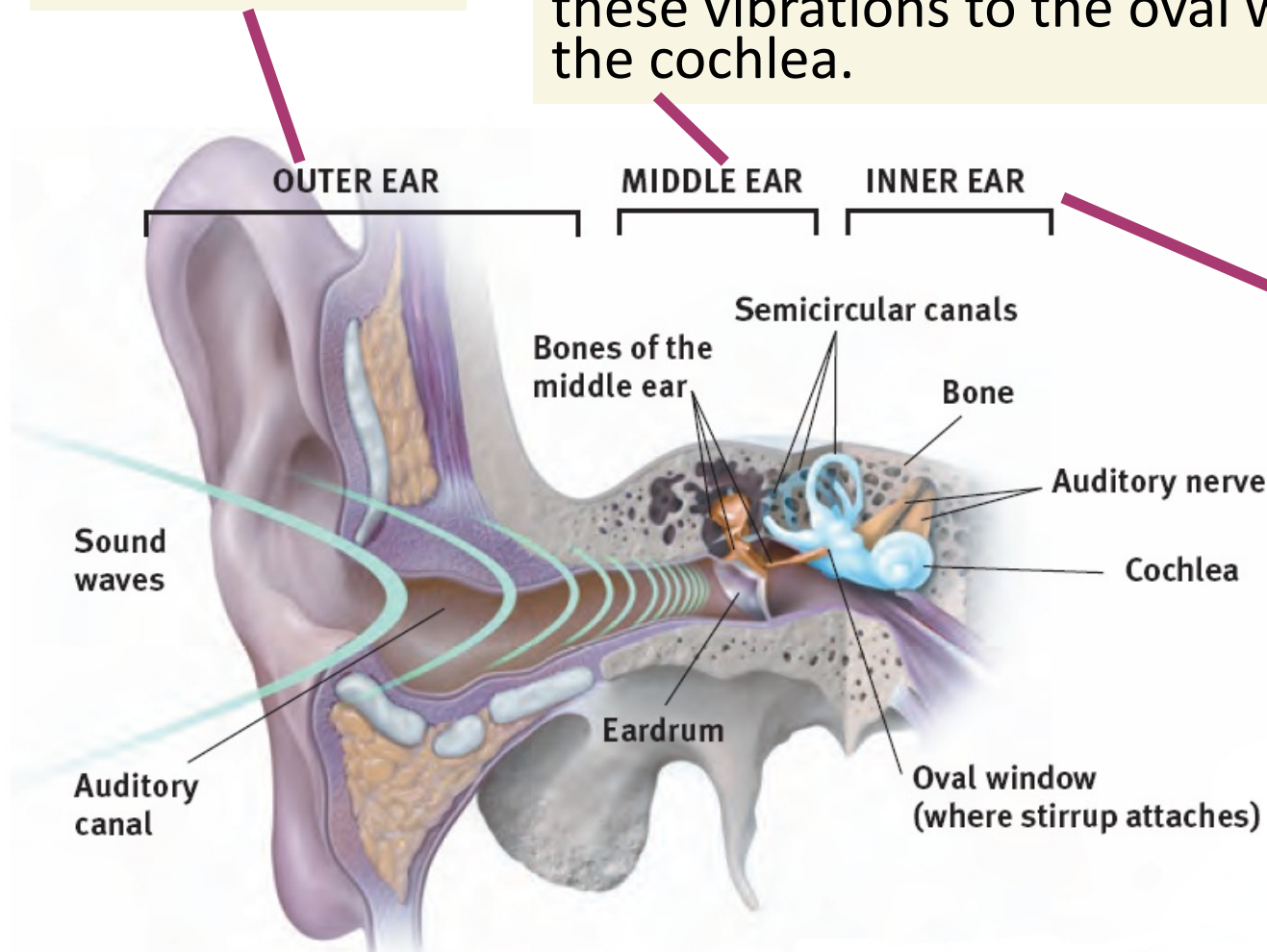
**Cochlea:** Coiled, bony, fluid-filled tube in the inner ear that transforms sound vibrations to auditory signals.



# Sound Waves Reach The Ear

The **outer ear** collects sound and funnels it to the eardrum.

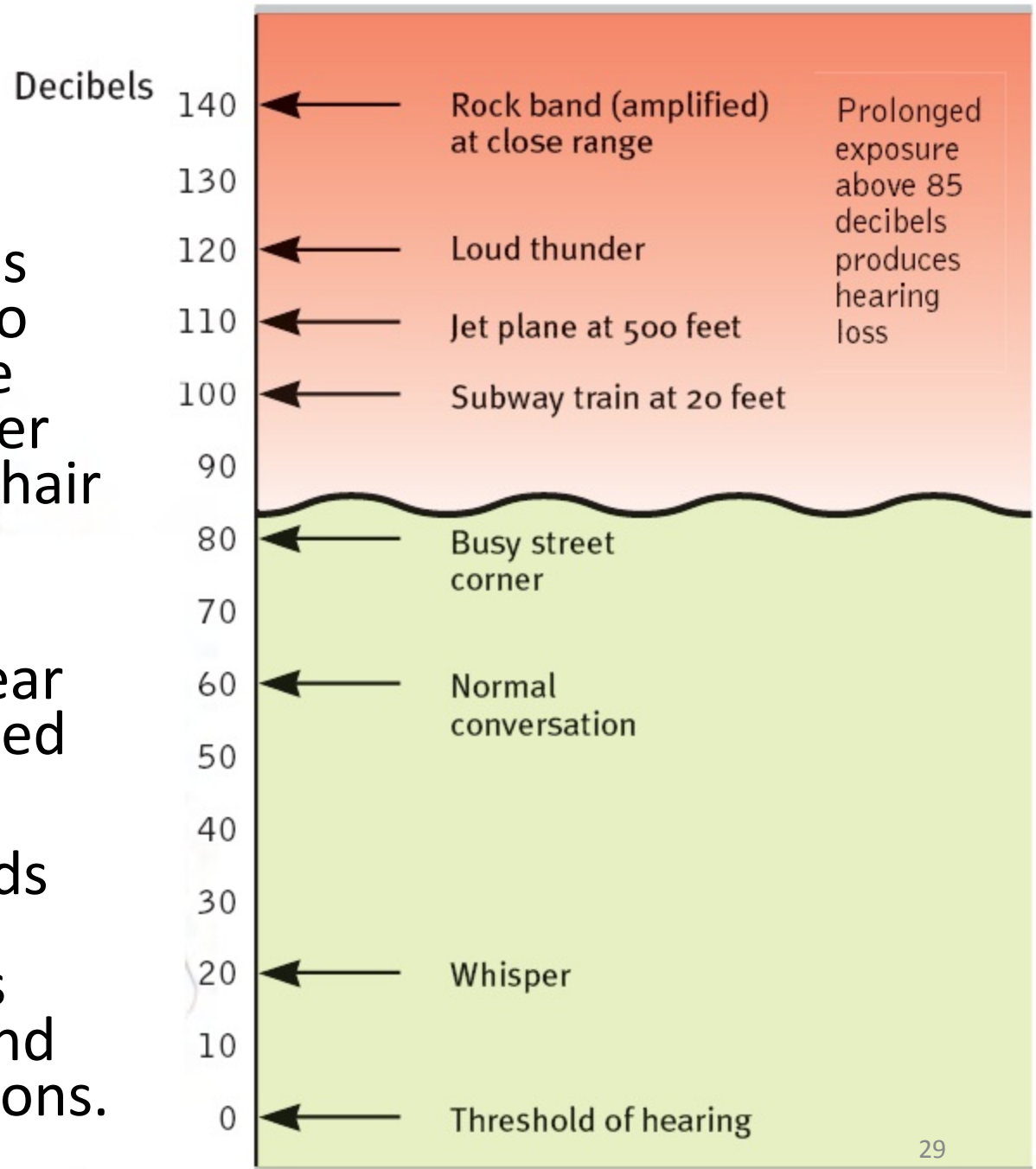
In the **middle ear**, the sound waves hit the eardrum and move the hammer, anvil, and stirrup in ways that amplify the vibrations. The stirrup then sends these vibrations to the oval window of the cochlea.



In the **inner ear**, waves of fluid move from the oval window over the cochlea's "hair" receptor cells. These cells send signals through the auditory nerves to the temporal lobe of the brain.

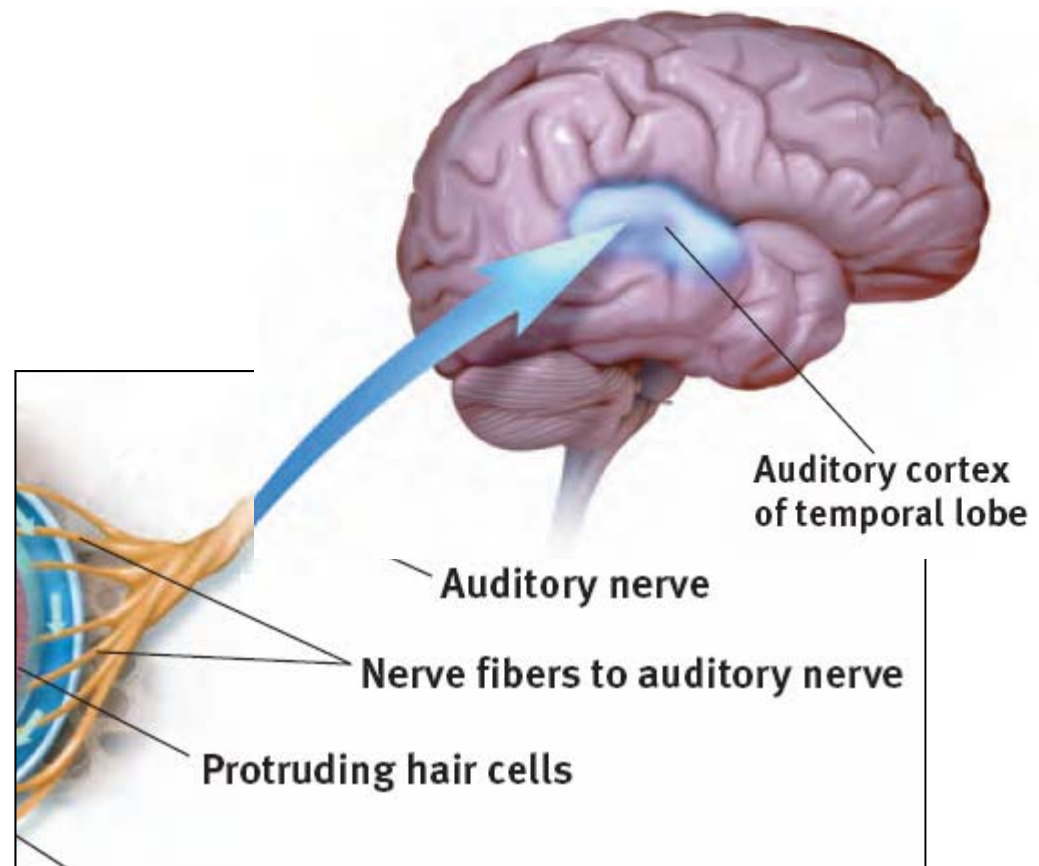
# Preventing Hearing Loss

- Exposure to sounds that are too loud to talk over can cause damage to the inner ear, especially the hair cells.
- Structures of the middle and inner ear can also be damaged by disease.
- Prevention methods include limiting exposure to noises over 85 decibels and treating ear infections.



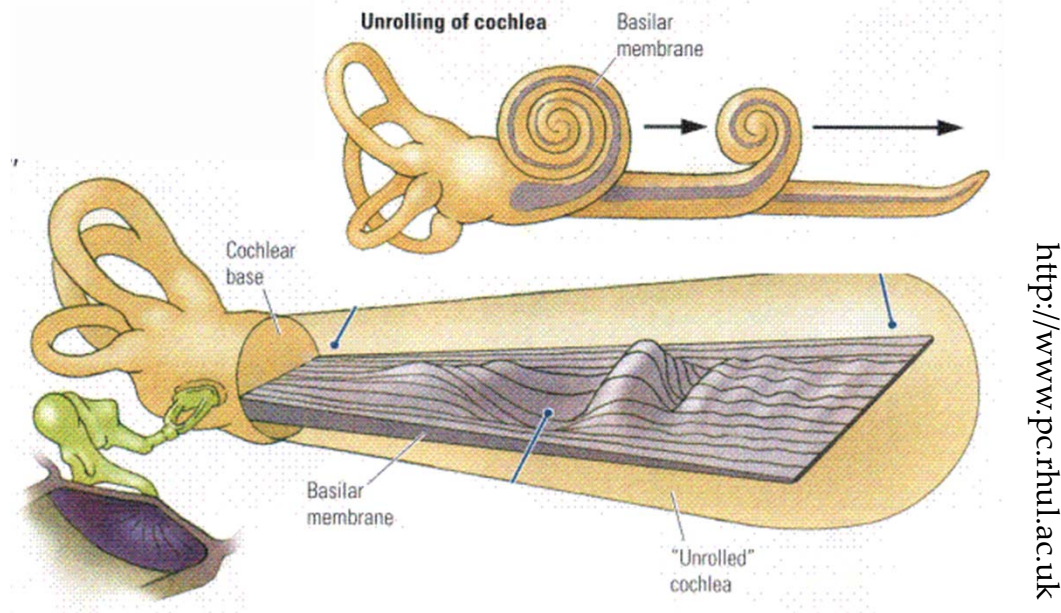
# Sound Perception: Loudness

- **Loudness** refers to more intense sound vibrations. This causes a greater **number** of hair cells to send signals to the brain.
- Soft sounds only activate certain hair cells; louder sounds move those hair cells AND their neighbors.



# Theories of Audition

**Place Theory** suggests that sound frequencies stimulate the basilar membrane at specific places resulting in perceived pitch.

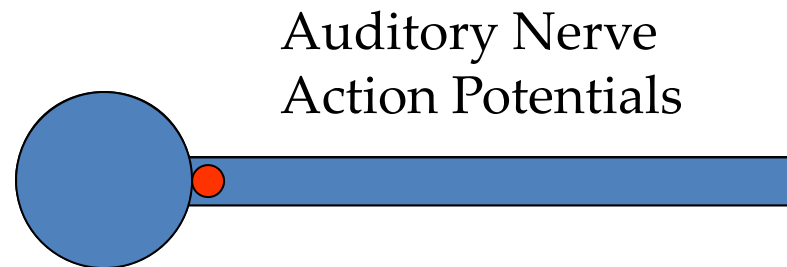


# Theories of Audition

**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.



Sound  
Frequency  
200 Hz





# Sound Perception: Pitch

How does the inner ear turn sound frequency into neural frequency?

Short wavelength = high frequency  
(bluish colors, high-pitched sounds)



Long wavelength = low frequency  
(reddish colors, low-pitched sounds)



## Place theory

At high sound frequencies, signals are generated at different locations in the cochlea, depending on pitch. The brain reads pitch by reading the location where the signals are coming from.

## Frequency theory

At low sound frequencies, hair cells send signals at whatever rate the sound is received.

## Volley Principle

At ultra high frequencies, receptor cells fire in succession, combining signals to reach higher firing rates.

# Localization of Sound

1. Intensity differences
2. Time differences

Time differences as small as  $1/100,000$  of a second can cause us to localize sound. The head acts as a “shadow” or partial sound barrier.

# 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.

## Taste

Our tongues have receptors for five different types of tastes, each of which may have had survival functions.



**Sweet:**  
energy source



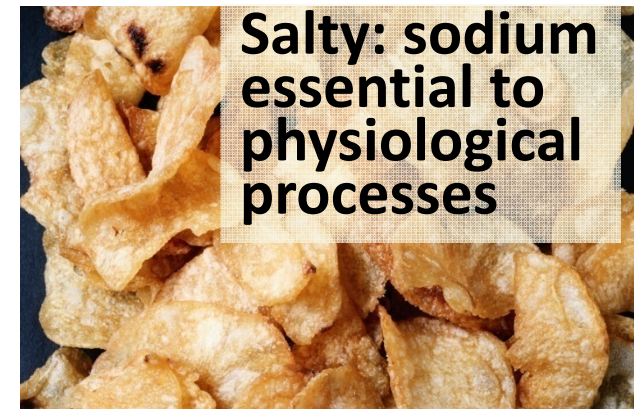
**Sour:**  
potentially toxic  
acid



**Umami:**  
(savoriness)  
proteins to grow  
and repair  
tissue



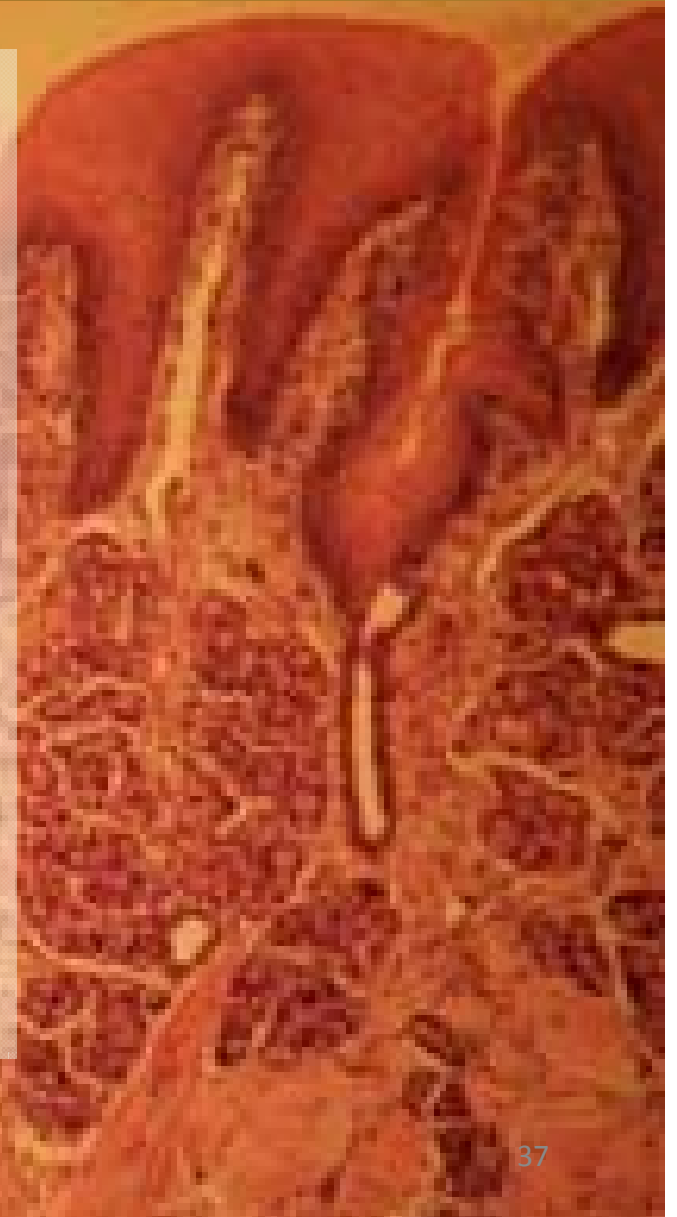
**Bitter:**  
potential  
poisons



**Salty:** sodium  
essential to  
physiological  
processes

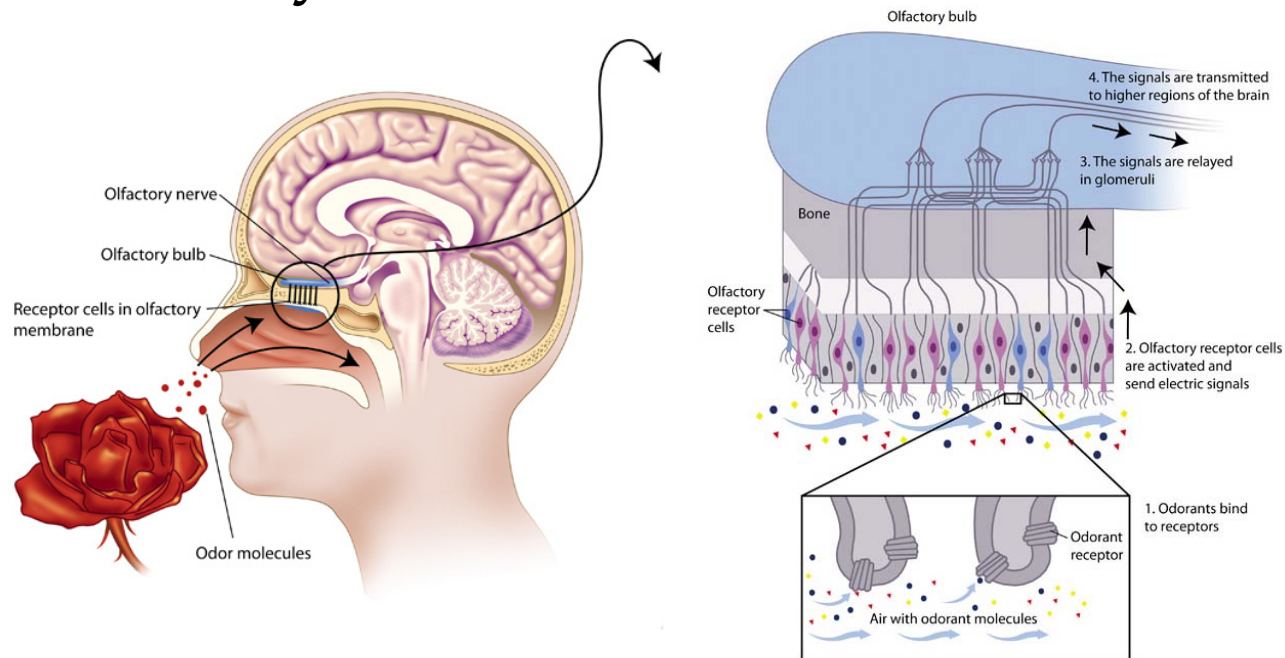
# Neurochemistry of Taste

- There are no regions of the tongue, just different types of taste receptor cells projecting hairs into each taste bud's pore.
- These cells are easily triggered to send messages to the temporal lobe of the brain.
- Burn your tongue? Receptors reproduce every week or two. But with age, taste buds become less numerous and less sensitive.
- Top-down processes still can override the neurochemistry; expectations do influence taste.



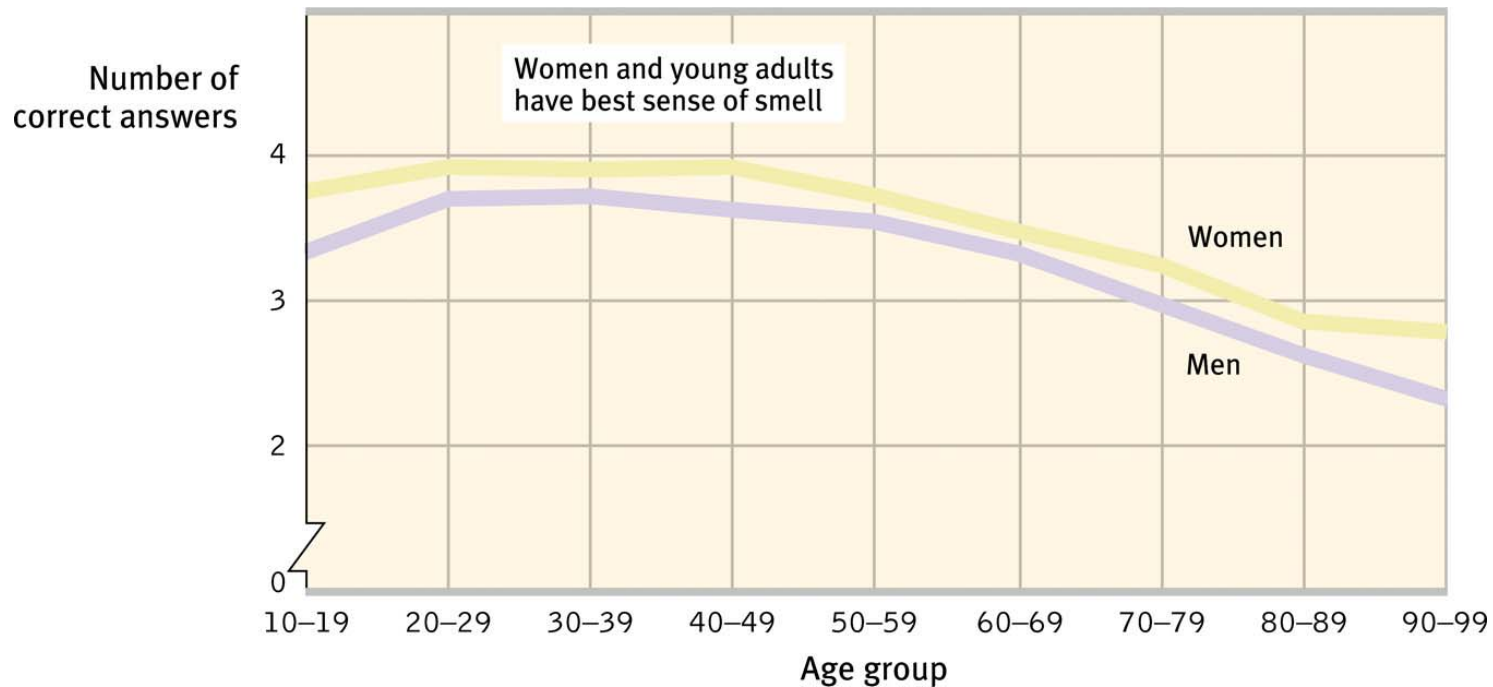
# Smell

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



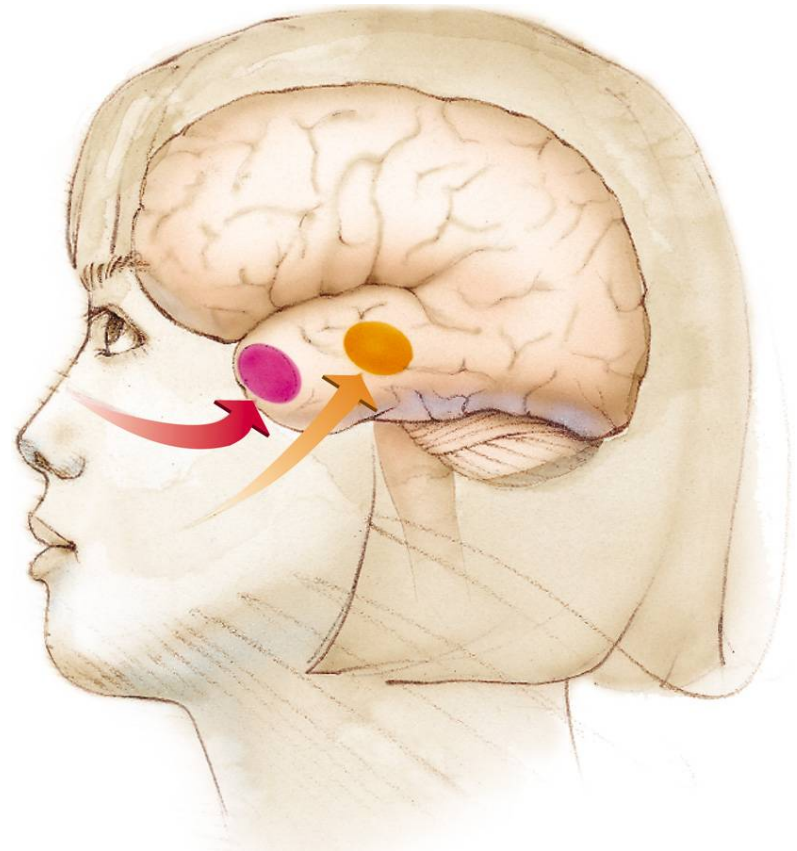
# Age, Gender, and Smell

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



# Smell and Memories

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





# Mixing the different senses together

**Sensory interaction** occurs *when different senses influence each other.*

For example:

- a burst of sound makes a dim light source more visible.
- flavor is an experience not only of taste, but also of smell and texture.
- seeing text or lip movement, or even feeling the puff of air from consonants, affects what words we hear.



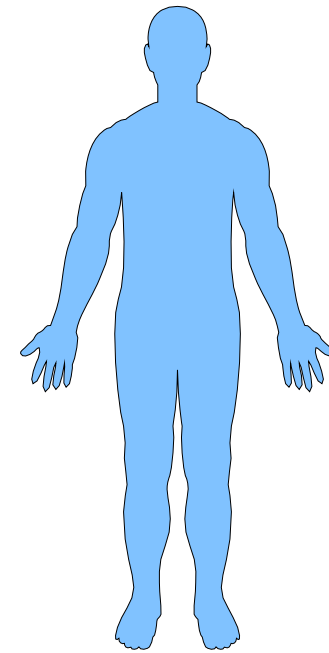
456789

**Synaesthesia** is a condition *when perception in one sense is triggered by a sensation in a DIFFERENT sense.*

Some people experience synaesthesia all the time, reporting that, “the number 7 gives me a salty taste” or “rock music seems purple.”

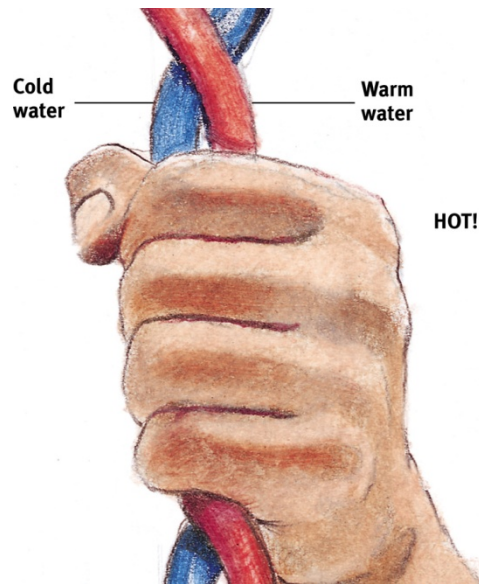
# Touch

The sense of touch is a mix of four distinct skin senses—pressure, warmth, cold, and pain.

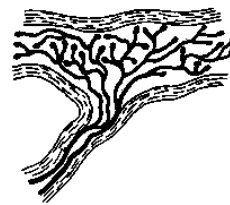


# Skin Senses

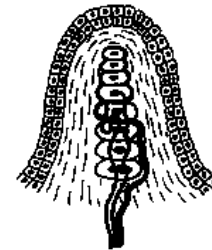
Only pressure has identifiable receptors. All other skin sensations are variations of pressure, warmth, cold and pain.



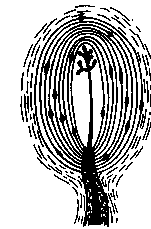
Burning hot



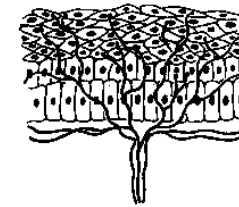
Pressure



Vibration



Vibration



Cold, warmth and pain

# Pain

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



AP Photo/Stephen Morton

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

# Biopsychosocial Influences

## Biological influences

- activity in spinal cord's large and small fibers
- genetic differences in endorphin production
- the brain's interpretation of CNS activity



## Psychological influences

- attention to pain
- learning based on experience
- expectation of pain relief



## Social-cultural influences

- presence of others
- empathy for others' pain
- cultural expectations



Personal  
experience  
of pain

# Gate-Control Theory

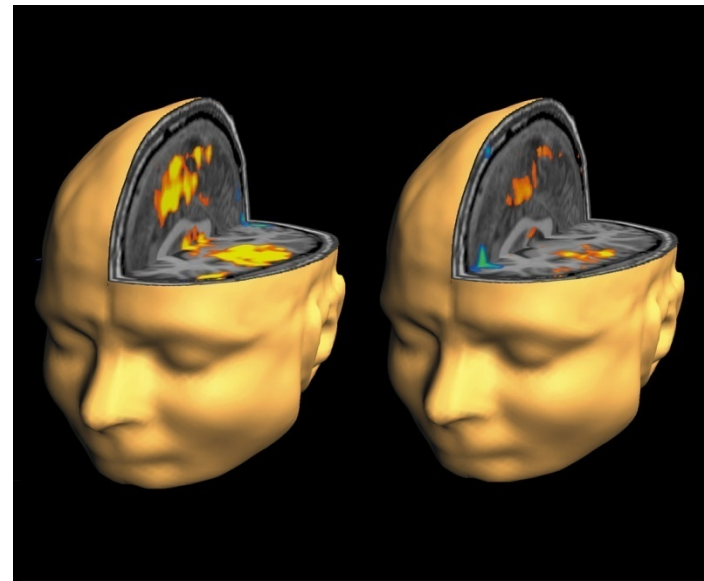
Melzack and Wall (1965, 1983) proposed that our spinal cord contains neurological “gates” that either block pain or allow it to be sensed.



Gary Comer/ PhotofakeUSA.com

# Pain Control

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



Todd Richards and Aric Vills, U.W.  
©Hunter Hoffman, [www.vrpain.com](http://www.vrpain.com)

# Sensing Body Position and Movement

- **Kinesthesia** (“movement feeling”) refers to sensing the movement and position of individual body parts relative to each other.
- **How it works:** sensors in the joints and muscles send signals that coordinate with signals from the skin, eyes, and ears
- Without kinesthesia, we would need to watch our limbs constantly to coordinate movement.





# Sensing Body Position and Movement

- **Vestibular sense** refers to the ability to sense the position of the head and body relative to gravity, including the sense of balance.
- **How it works:** fluid-filled chambers in the inner ear (vestibular sacs and semicircular canals) have hairlike receptors that send messages about the head's position to the cerebellum
- Vestibular sense serves as the human gyroscope, helping us to balance and stay upright.

