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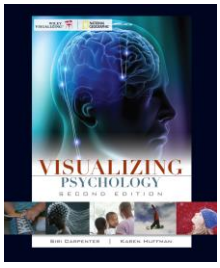
CHAPTER 4

Sensation & Perception

How many senses do we have? Name them.



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Lecture Overview

- Understanding Sensation
- How We See & Hear
- Our Other Senses
- Understanding Perception

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Introduction to Sensation & Perception

- **Sensation:** process of receiving, translating, & transmitting raw sensory information from the external & internal environments to the brain
- **Perception:** process of selecting, organizing, & interpreting sensory data into mental representations of the world

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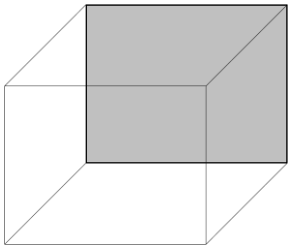

Where are the top, bottom and sides of the cube?

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Figure 4.20
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Old lady looking down or young woman looking over her right shoulder?

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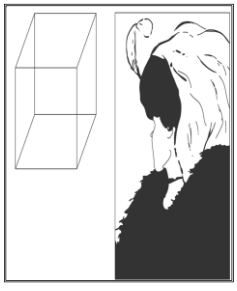
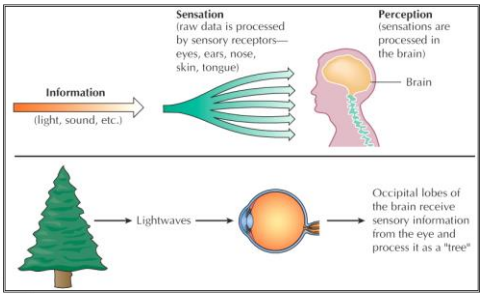
Sensation vs. Perception



- Top or bottom of cube?
- Young or old woman?
- When viewing these figures, your visual sensory system receives an assortment of light waves = **sensation**. Interpreting the lines as a cube or an old/young woman = **perception**.

Sensation vs. Perception



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Understanding Sensation: Processing

- Processing: five senses (vision, audition, etc.) have special receptors (e.g., eye's rods & cones), which detect & transmit sensory information

Sense	Stimulus	Receptors
Vision	Light waves	Light-sensitive rods and cones in eye's retina
Audition (hearing)	Sound waves	Pressure-sensitive hair cells in ear's cochlea
Olfaction (smell)	Molecules dissolved on nose's mucous membranes	Neurons in the nose's olfactory epithelium
Gustation (taste)	Molecules dissolved on tongue	Taste buds on tongue's surface
Body Senses	Variety of stimuli	Variety of receptors

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Understanding Sensation: Processing

Three Forms of Processing:

1. Transduction: physical stimulus is converted into neural impulses, which are sent on to the brain
2. Coding: converting a particular sensory input into a specific sensation
3. Sensory Reduction: filtering & analyzing incoming sensations before sending a neural message on to the cortex

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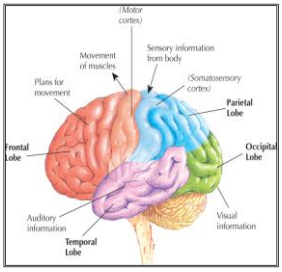
Understanding Sensation: Processing

- Neural impulses from sensory receptors in our eyes, ears, skin, & other sensory organs create neural messages sent to various areas of our brain.



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Understanding Sensation

- Sensory Adaptation: repeated or constant stimulation decreases the number of sensory messages sent to the brain, which causes decreased sensation

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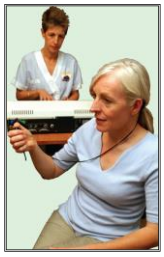
Pause & Reflect: Assessment

- Smokers generally fail to notice that their hair & clothing often smell like smoke. This may be because of Sensory Adaptation

Understanding Sensation: Measuring the Senses

- Psychophysics: studies the link between physical characteristics of stimuli & our sensory experience
- Absolute Threshold: smallest amount of a stimulus we can reliably detect
- Difference Threshold: minimal difference needed to detect a stimulus change; also called the "*just noticeable difference*" (JND)



Thresholds

ABSOLUTE THRESHOLDS FOR VARIOUS SENSES

Sense	Stimulus	Absolute Threshold
Vision	Light energy	A candle flame seen from 30 miles away on a clear, dark night
Hearing	Sound waves	The tick of a watch at 20 feet
Taste	Chemical substances that contact the tongue	One teaspoon of sugar in two gallons of water
Smell	Chemical substances that enter the nose	One drop of perfume spread throughout a six-room apartment
Touch	Movement of, or pressure on, the skin	A bee's wing falling on your cheek from a height of about half an inch

Pain Perception

- How do we perceive pain?
- Gate-Control Theory: pain sensations are processed & altered by mechanisms within the spinal cord

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Pain Perception

In certain situations, the body releases natural painkillers called *endorphins*.

"Runner's High"

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Pain Perception

•Brain can generate pain on its own

•Phantom limb pain – nerve cells send conflicting messages to the brain. Because it arises in part of spinal cord responsible for pain signaling, brain interprets as pain.

•Prosthetic limbs can cause pain to disappear

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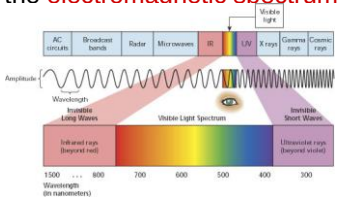
How We See & Hear: Vision

- Light is a form of electromagnetic energy that moves in waves.
- Various types of electromagnetic waves form the electromagnetic spectrum.



How We See: Electromagnetic Spectrum

- The flower on the left is what we normally see. The one on the right, photographed under ultraviolet light, is what we think most animals & insects see.

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How We See & Hear: Hearing

- In contrast to light waves, which are particles of electromagnetic energy, sound waves are produced by air molecules moving in a particular wave pattern. For example, when an impact or vibrating objects, such as vocal cords or guitar strings, cause a sudden change in air pressure.

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Study Organizer 4.1 Properties of vision and hearing

Physical Properties	Wavelength: The distance between successive peaks.	Wave amplitude: The height from peak to trough.	Range of wavelengths: the mixture of waves.
	Time → *Long wavelength/low frequency*	Time → *Low amplitude/low intensity*	Time → *Low range/low complexity*
	Time → *Short wavelength/high frequency*	Time → *High amplitude/high intensity*	Time → *High range/high complexity*
VISION (Light waves)	**Hue:** Short wavelengths produce higher frequency and bluish colors; long wavelengths produce lower frequency and reddish colors.	**Brightness:** Great amplitude produces more intensity and bright colors; small amplitude produces less intensity and dim colors.	**Saturation:** Wider range produces more complex color; narrow range produces less complex color.
AUDITION (Sound waves)	**Pitch:** Shorter wavelengths produce higher frequency and high-pitched sounds; long wavelengths produce lower frequency and low-pitched sounds.	**Loudness:** Great amplitude produces louder (more intense) sounds; small amplitude produces soft sounds.	**Timbre:** Wider range produces more complex sound with a mix of multiple frequencies. Narrower range produces less complex sound with one or a few frequencies.

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Light & Sound Waves

- Wavelength: distance between the crests (or peaks)
- Amplitude: height of a light or sound wave
- Range: mixture of waves

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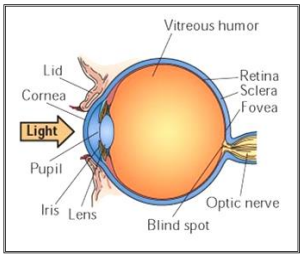
How We See: Anatomy of the Eye



- The function of the eye is to capture light waves & focus them on receptors at the back of the eyeball.

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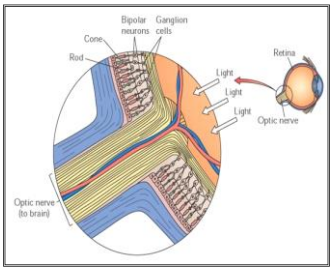
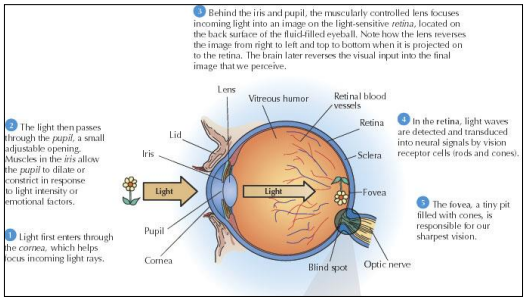
How We See: Structures of the Retina

- Receptors for vision are the rods & cones located in the retina.





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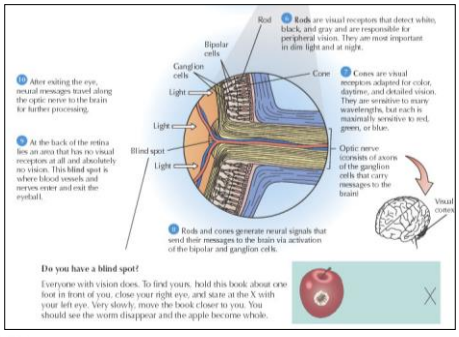

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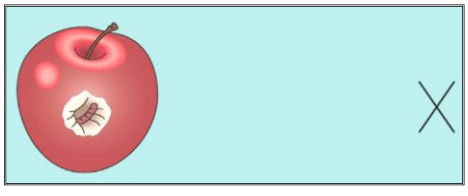
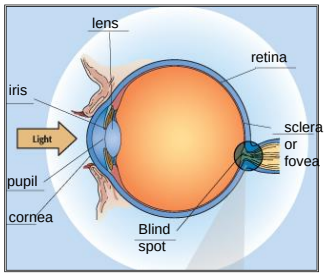
Do You Have a Blind Spot?



- (Everyone does! Close your right eye & stare at the X with your left eye, & then slowly move your head toward the screen. The worm will disappear!)

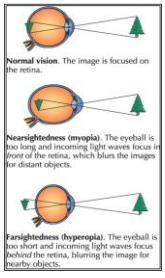
Pause & Reflect: Assessment

- Enter the correct label on each line, & then compare your answers with Process Diagram (p. 93).



Pause & Reflect: Psychology & Life

- Vision research helps explain how the shape of your eyeball creates two common visual problems-- nearsightedness & farsightedness.

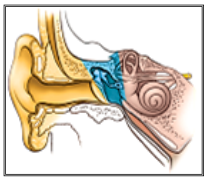


How We Hear: Audition

- Sound results from movement of air molecules in a particular wave pattern.
- Sound waves vary in:
  - Wavelength, which determines *pitch* (highness or lowness).
  - Amplitude (height), which determines *loudness* (intensity of the sound).

How We Hear:
Ear Anatomy

- Outer Ear (gold color) = pinna, auditory canal, & eardrum
- Middle Ear (blue color) = hammer, anvil, & stirrup
- Inner Ear (pinkish color) cochlea, semicircular canals, & vestibular sacs
  - Cochlea contains key receptors for hearing



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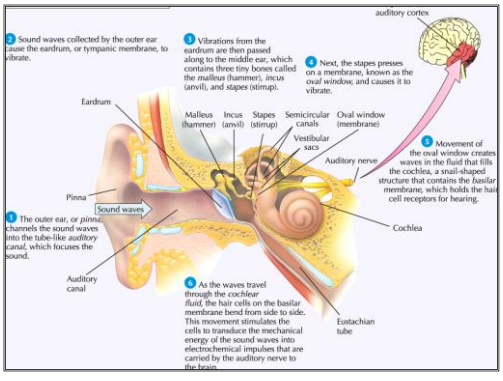

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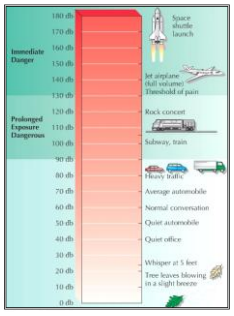
How We Hear:
Theories of Pitch Perception

- Place Theory: pitch perception is linked to the particular spot on the cochlea's basilar membrane that is most stimulated
- Frequency Theory: pitch perception occurs when nerve impulses sent to the brain match the frequency of the sound wave

How We Hear: Audition



- The loudness of a sound is measured in *decibels*. Constant noise above 90 decibels can cause permanent nerve damage & irreversible hearing loss.

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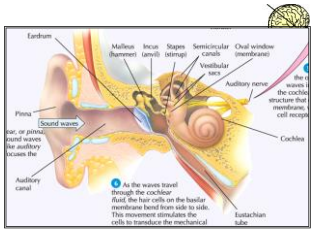
Pause & Reflect: Assessment

- Enter the correct label on each line, & then compare your answers with Process Diagram (p. 94).



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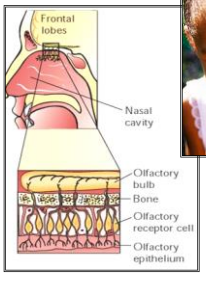
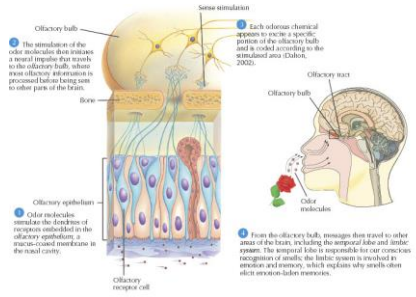
Our Other Senses: Smell, Taste, & the Body Senses

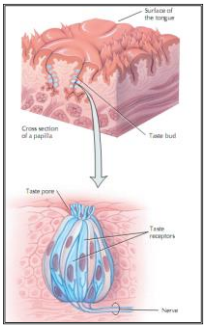
- Olfaction: sense of smell
- Receptors for smell are embedded in the nasal membrane (the olfactory epithelium).



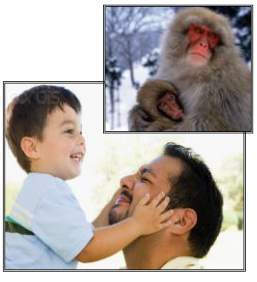


Our Other Senses: Gustation (Taste)

- Receptors for taste (or gustation) are taste buds, located in papillae on the surface of the tongue.

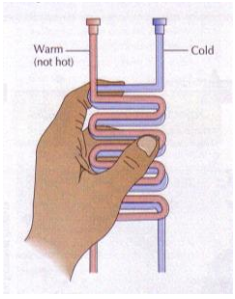


Our Other Senses: Three Body Senses (Skin, Vestibular, & Kinesthesia)

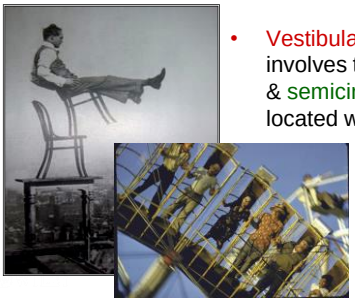


- Skin senses involve three skin sensations--touch (or pressure), temperature, & pain.
- Receptors for these sensations occur in various concentrations & depths in the skin.

Sense of Hot



Our Other Senses:
Three Body Senses



- Vestibular sense (balance) involves the vestibular sacs & semicircular canals located within the inner ear.

Our Other Senses:
Three Body Senses

- Kinesthesia provides our brains with information about posture, orientation, & movement.
- Kinesthetic receptors are located in muscles, joints, & tendons.

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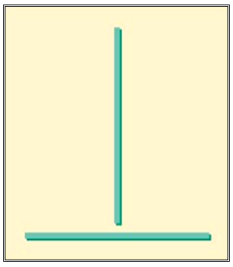
Understanding Perception

- Illusion: false or misleading perception that helps scientists study the processes of perception
- The horizontal-vertical illusion Which line is longer?



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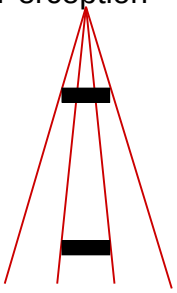
Understanding Perception

Which dark line is longer?

Converging lines provide depth cues telling you top line is further away and therefore larger.



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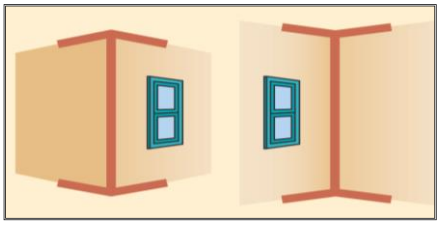
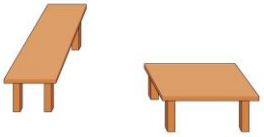
The Muller-Lyer Illusion
Which vertical line is longer?



People in urban areas perceive right line as larger line.

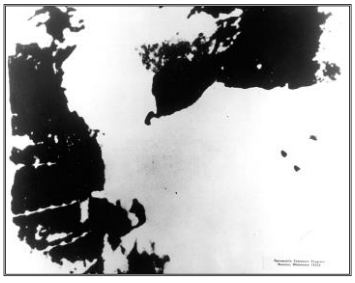
Shepard's tables



Do these two table tops have the same dimensions? Get a ruler and check it for yourself.

Understanding Perception

- Do you see the cow?



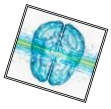
Understanding Perception

- Perception's three basic processes:

1. Selection
2. Organization
3. Interpretation

Selection

- Selection (choosing where to direct attention) involves:
  - Selective Attention: filtering out & attending only to important sensory messages
  - Feature Detectors: specialized neurons that respond only to certain sensory information
  - Habituation: brain's tendency to ignore environmental factors that remain constant



Pause & Reflect: Critical Thinking

- Kittens reared in an environment having only vertical lines are later unable to detect horizontal lines. Can you explain why?

Understanding Perception: Organization

- Organization: assembling information into patterns that help us understand the world
- We *organize* sensory information in terms of:
  - Form
  - Constancy
  - Depth
  - Color

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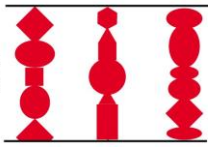
Organization: Gestalt Principles

Figure–Ground:
Objects (the *figure*) are seen as distinct from the surroundings (the *gound*). (Here the red objects are the figure and the yellow backgound is the ground).



Proximity:
Objects that are physically close together are grouped together. (In this figure, we see 3 groups of 6 hearts, not 18 separate hearts.)

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Organization: Gestalt Principles

Continuity:
Objects that continue a pattern are grouped together.

When we see this,

we normally see this

plus this.

Not this.

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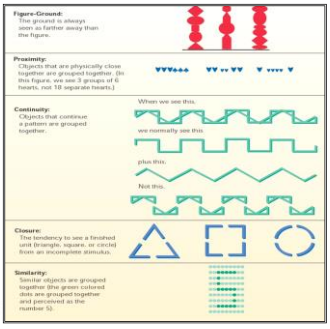
Organization: Gestalt Principles

Closure:
The tendency to see a finished unit (triangle, square, or circle) from an incomplete stimulus.

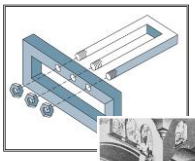
Similarity:
Similar objects are grouped together (the green colored dots are grouped together and perceived as the number 5).

Organization: Gestalt Principles



Pause & Reflect: Psychology & Life

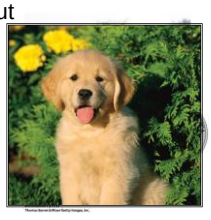
- Perception research helps explain these so-called "impossible figures."



Impossible Movie

Organization: Perceptual Constancy

- Perceptual Constancy: perceiving the environment as remaining the same even with changes in sensory input
- Four best-known constancies:
  - Size
  - Shape
  - Color
  - Brightness



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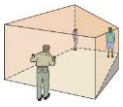
Organization: Shape Constancy

- Ames Room Illusion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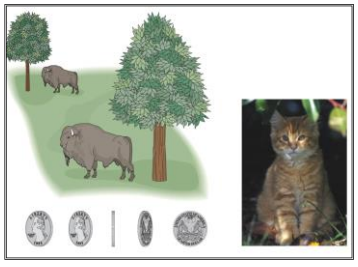
Pause & Reflect: Assessment

- Can you label these examples of size, shape, color, & brightness constancies?



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Organization: Depth Perception

- Depth Perception: ability to perceive three dimensional space & accurately judge distance

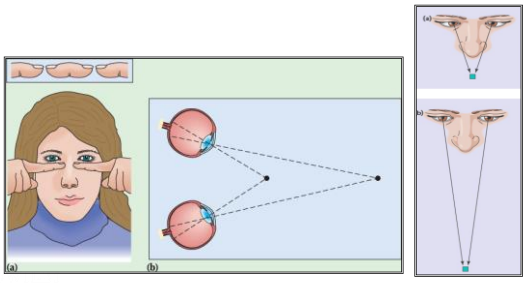
Depth Perception:

- Depth perception involves both binocular (two eyes) & monocular (one eye) cues.

- Brain fuses two images into one – stereoscopic vision
- Two binocular depth cues:
  - Retinal Disparity (separation of the eyes causes different images to fall on each retina)
  - Convergence (the closer the object the more the eyes *converge*, or turn inward)

Binocular Cues:

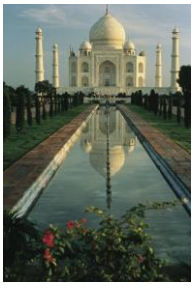
Retinal disparity (left) & Convergence (right)



Pause & Reflect: Assessment

- Can you label these 7 monocular depth cues?

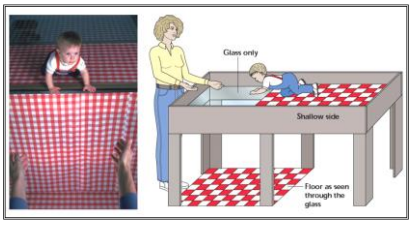
1. Linear perspective
2. Interposition
3. Relative size
4. Texture gradient
5. Aerial perspective
6. Light & shadow
7. Relative height



Monocular Clues

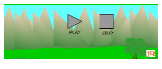
Depth Perception: Continued

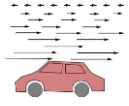
- Visual cliff —infants hesitate to crawl over the glass, demonstrating some depth perception



Monocular Cues

- **Accommodation**: muscles that adjust shape of lens as it focuses on an object send neural impulses to the brain which interpret to perceive distance.
- **Motion parallax**: when moving, close objects appear to wiz by whereas far objects seem to move slowly or appear stationary.





How We See:
Theories of Color Vision

- *Color vision* is a combination of *two* theories

1. Trichromatic Theory: color perception results from mixing three distinct color systems--red, green, & blue

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How We See:
Theories of Color Vision

2. Opponent-Process Theory: color perception based on three systems of color receptors, each of which responds in an on-off fashion to opposite color stimuli (blue-yellow, red-green, & black-white)

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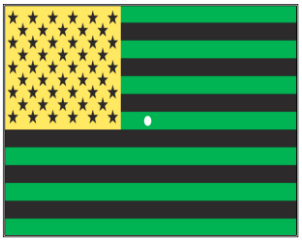
Pause & Reflect: Assessment

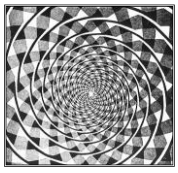
- Stare at the dot in the middle of the flag for 60 seconds. Then look at a white surface. You'll see a regular red, white, & blue U.S. flag, known as a *negative afterimage*. Can you explain how this is related to the *opponent-process theory*?



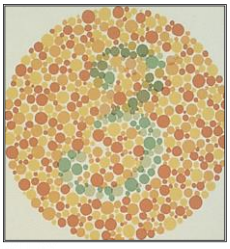
Pause & Reflect: Assessment

- Click on the photo of the spiral to the right & follow the directions on the website. How does the opponent-process theory help explain the effects of this aptly named "spiral illusion"?

http://dogfeathers.com/java/spirals.html



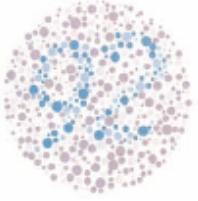
Color-Deficient Vision



- Are you "color blind"? People who have red-green color deficiency have trouble perceiving the green colored number in the center of this circle.

Color-Deficient Vision

Blue-Yellow Deficiency



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Understanding Perception: Interpretation

- Interpretation (how the brain explains sensations) involves four major factors:

1. Perceptual Adaptation: brain adapts to changed environments
2. Perceptual Set: readiness to perceive in a particular manner, based on expectations
3. Frame of Reference: based on the context of the situation
4. Bottom-Up vs. Top-Down Processing: information processing that begins at the bottom or top

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Pause & Reflect: Assessment

- Do you notice anything wrong with these photos of actress Julia Roberts?

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Pause & Reflect: Assessment

- Now that the photos are inverted, can you explain how this is an example of perceptual set?

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Understanding Sensation: Processing

When first learning to read, you used bottom-up processing. You initially learned that certain arrangements of lines and "squiggles" represented specific letters. You later realized that these letters make up words.

Now, yuor aiblity to raed uisng top-dwon pressoing mkaes it psosible to unedrstnad thsi sntenece desipte its mnay mssipllengis.

- Bottom-Up Processing: information processing beginning "at the bottom" with raw sensory data" sent "up" to the brain for higher-level analysis
- Top-Down Processing: information processing starting "at the top" with higher-level processes & then working down

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Pause & Reflect: Assessment

1. How the brain explains sensations is known as interpretation
2. Perceptual Adaptation: brain adapts to changed environments
   Perceptual Set: readiness to perceive in a particular manner, based on expectations

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Pause & Reflect:

Which Gestalt principal does this picture demonstrate?

closure

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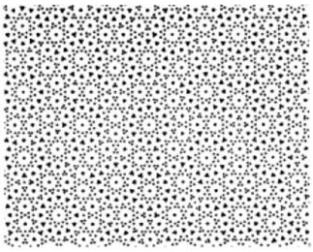

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Pause & Reflect: Psychology & Life

- **Subliminal** perception may occur, but there is little or no evidence of *subliminal persuasion.*

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Science & E.S.P.

- Extrasensory Perception (ESP): supposed "psychic" abilities that go beyond the known senses (e.g., telepathy or clairvoyance)
- ESP research is criticized for its lack of stability & replicability.

End of CHAPTER 4

Sensation & Perception