Sensation & Perception

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Psychology

Unit Standard:

SSPBF4: The student will describe how the physical world is translated into a psychological experience.

- Describe the basic structures of the eye and ear, the associated neural pathways, and the process of sensory transduction
- Recognize causes which can lead to hearing and vision deficits: include environmental causes, aging, genetics, diet, disease, and trauma.
- Describe the major theories associated with visual and auditory sensation and perception: include opponent process theory and trichromatic theory of vision, frequency theory, volley theory, and place theory of hearing.
- Analyze different perceptual illusions and describe why illusions are important for our understanding of perception.
- Compare top-down and bottom-up processing.

Sensation vs. Perception

Sensation: the process by which our sensory receptors receive stimuli from our environment.

- There are five senses:
    a. Sight
    b. Hearing
    c. Smell
    d. Taste
    e. Touch

Perception: the process by which our brain organizes and interprets information from our senses

Basic Principles of Sensation & Perception

Sensation & Perception work together to help us understand the world and our place in it.
Types of Processing:

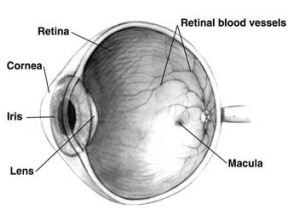
1. Bottom-Up Processing
    a. Begins with the sensory receptors and transfers it to the brain
    b. Detects stimuli from the environments
    c. Ex: color, lines, pitch, tone, salty, sweet, etc.
2. Top-Down Processing
    a. Constructs understanding from the sensory input
    b. Interpretation of what the senses detect
    c. Influenced by prior experiences

Analyze the image using both bottom-up and top-down processing.

Process of Transduction

Transduction is the process by which the stimulus is converted into neural impulses our brains can interpret.

Ex: Light waves into Electrical Impulses



Steps in the Process:

1. Stimuli triggers sensory receptor cells
2. Sensory receptor cells transform stimulation into a neural (electrical) impulse
3. Afferent (sensory) Neurons deliver information to the brain
4. Brain interprets and organizes the sensory input

The brain is being constantly bombarded by thousands of stimuli, how does it make sense of it all?

Thresholds

Absolute Threshold

- The least amount of stimulation needed to detect a particular stimulus at least 50% of the time

Subliminal:

- Stimuli that is below a person's absolute threshold, but may still have an effect

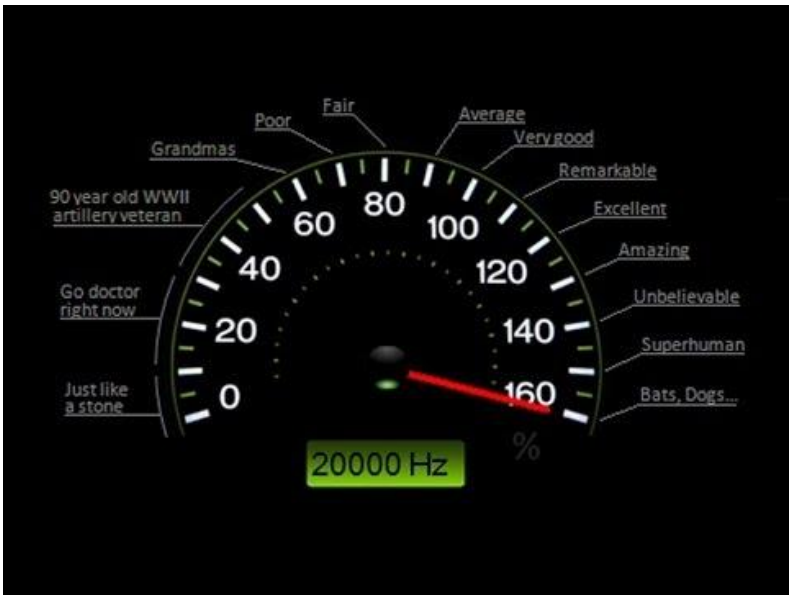
Priming Effect:

- An unnoticed stimuli that may prepare you for later stimuli

Difference Threshold (Just Noticeable Difference)

- The minimum difference needed between two stimuli required for detection at least 50% of the time.
- Example:
  - Being able to identify a specific child's cry in a roomful of crying children.
  - A musician must be able to tell difference between F and F#
- Weber's Law: the principle that in order for a difference to be detected, it must differ by a constant minimum percentage.
  - Ex. 1 oz added to 10 oz = detectable
  - But 1 oz added to 100 oz, not detectable

Directions: Raise your hand when you hear the sound, then take your hand down when you can no longer hear it.



Sensory Adaptation:

Sensory Adaptation: reduced sensitivity in response to constant stimulation

- When constantly exposed to a stimulus that does not change, we become less aware of it.
- Neurons begin to fire less frequently
  - Examples:
    - Pressure and rub of the clothes on our bodies
    - Sound of the heating/air conditioning
    - Hum of appliances
    - Smell of a classroom
  - Eyes are constantly moving, so images do not fade

Impact of Sensory Adaptation:

- Sensory Adaptation allows the brain to focus on informative changes in the environment
- Explains why we are drawn to television:
  - Images are constantly flickering
  - Cuts, editing, panning, zooming and sudden noises draw attention
- Helps us respond appropriately to changes in the environment and with people
- Some people with autism have difficulty filtering stimuli, brain becomes overloaded.

Perceptual Set & Context Effects:

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

- Idea that our own beliefs and experiences impact what we sense
- What we sense can be impacted by what we are told to sense.
  - Ex. Photo of Loch Ness Monster
  - Taste tests

Context Effect: immediate clues that can influence what we perceive about our senses.

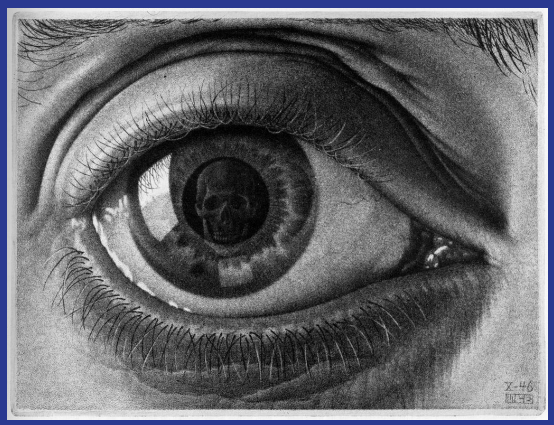
- Smaller size = further away
- When feeling threatened, a person is more likely to see something in a person's hand as a gun.

Review:

1. What is the difference between **sensation** and **perception**?
2. What is meant by **Bottom-Up Processing** and **Top-Down Processing**?
3. How do **Absolute Threshold** and **Difference Threshold** differ?
4. What is **Weber's Law**? Give an example.
5. How might we be influenced by stimuli below our absolute threshold?
6. What is the function of **Sensory Adaptation**?
7. What is the impact of **sensory adaptation**?
8. How do our expectations, beliefs, contexts, and/or prior experiences influence our perceptions?

The Senses - Vision

Identify the parts of the eye and describe their functions.

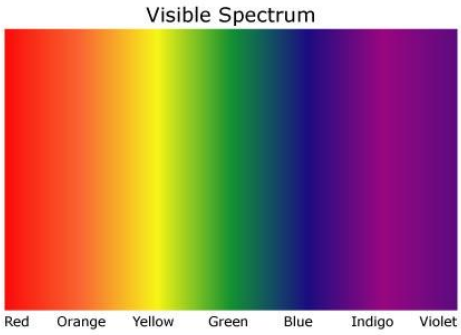


Parts of the Eye:

Cornea	Protects the eye and help filter light waves entering the eye
Iris	Expands and contracts to allow lights to enter the eye
Pupil	Opening of the iris where light waves enter the eye
Lens	Focuses the light waves onto the retina
Retina	Coating on the back of the eye that contains the light sensitive receptor cells (rods & cones)
Fovea	Part of the retina with the most light sensitive receptor cells (mostly cones)
Cones	Color visual receptor cells, require a lot of light, mainly in center
Rods	Visual receptor cells sensitive light, but not color. See grayscale, peripheral vision
Optic Nerve	Nerve that carries impulses from the retina to the brain

Vision:

- Light travels in waves. The shape of those waves influences what we see.
- Wavelength (distance of one wave to the next) determines **hue** (color)
- **Amplitude** (height of the wave) determines intensity
- Visible Light Spectrum for Humans = **ROY G. BIV**:
  - Red
  - Orange
  - Yellow
  - Green
  - Blue
  - Indigo
  - Violet



How We See:

1. Light waves pass through the cornea into the pupil.
2. Lens focuses the light waves onto the **Retina**
3. Rods & Cones in the back of the retina trigger bipolar cells
4. Bipolar cells send neural impulses to Ganglion Cells.
5. The axons of the Ganglion Cells interconnect to form the Optic Nerve
6. The Optic Nerve carries the neural messages to the Visual Cortex in the Occipital Lobe at the back of your brain

Fun Eye Facts!

- The Iris expands and contracts based on light levels
- The Retina has 6 million cones and 120 million rods
- Where the Optic Nerve leaves the eye, there is a blind spot
- Cones need lots of light to “see”
- Rods can “see” in faint light (night vision)

Visual Information Processing:

The processing of visual information begins in the retina.

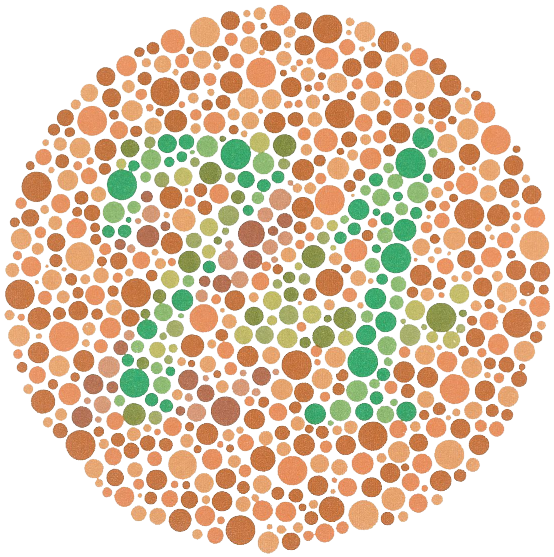
There are several ways the brain processes visual stimuli:

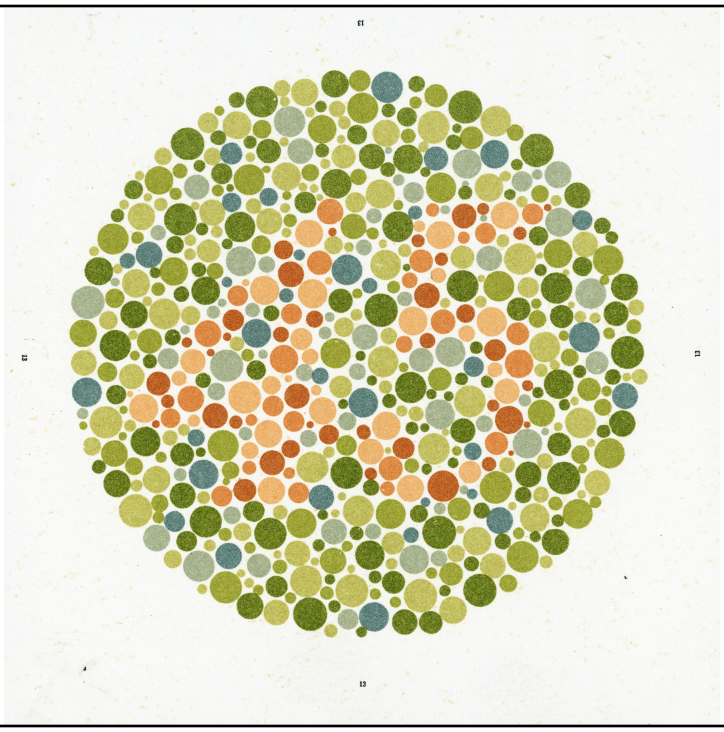
- **Feature Detection**: nerve cells in the brain that respond to specific features of a stimuli such as edges, lines, and angles
- **Parallel Processing**: brain processes many aspects of a visual stimuli at the same time
  - Features (forms)
  - Motion
  - Depth
  - Color

Prosopagnosia - A Feature Detection Disorder

Sensing Color:

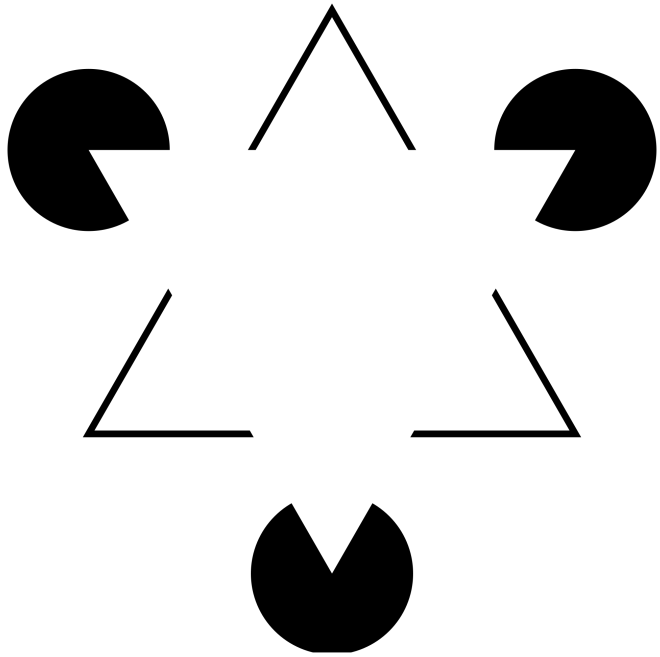
- Color is the result of a light wave reflection.
  - A tomato is red, because the red light wave is reflected
- **Trichromatic Theory** (Young-Helmholtz)
  - The Retina has three types of color receptors (cones)
  - Each type of color receptor analyzes a specific class of colors (Red, Blue, or Green)
  - Different colors result from light stimulating different combinations of color receptors
- **Opponent Process Theory:** theory that opposing retinal processes enable color vision. *(seen through afterimages)*
  - Color cells are turned on or off in combinations.
  - red /green, black/white, yellow/blue
- Most people can differentiate between thousands of subtle variations of color
- 1 in 50 people suffer from color blindness
  - Mainly males
  - Most common form is red/green colorblindness





Form Perception:

- **Figure & Ground:** organization of visual field into objects (figures) that stand out from their surroundings (ground)
- **Grouping**: the perceptual tendency (likelihood) to organize stimuli into meaningful groups
  - **Proximity** - group figures that are close to each other
  - **Continuity** - perceive continues patterns
  - **Closure** - fill in gaps to create a whole image

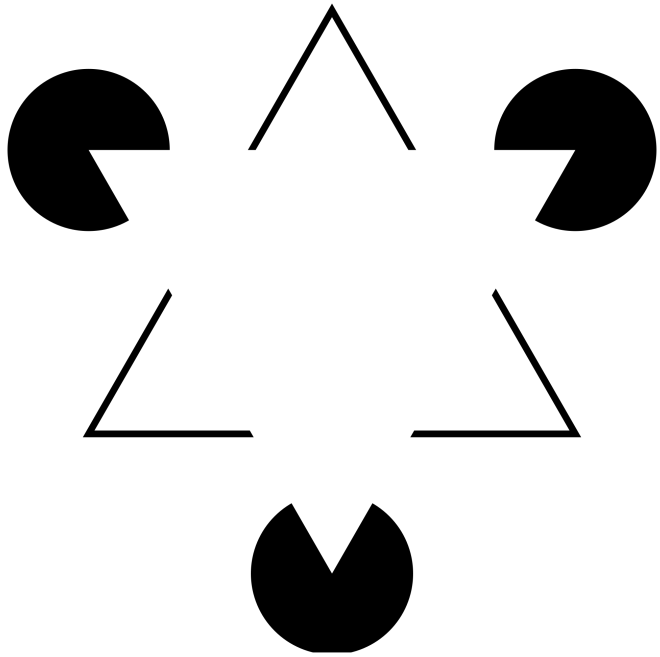


Depth Perception

Depth Perception: ability to see objects in three dimensions and judge distances

There are several ways we perceive dimension:

- Binocular Clues:
  - A depth cue that requires both eyes to function
  - Retinal Disparity:
    - eyes see two images that are processed to become one image
    - Subtle differences between the two images
    - The greater the disparity (difference) between the two images, the closer they are
- Monocular Cues:
  - A depth cue that requires only one eye to function
    - Includes size constancy, linear perspective & interposition



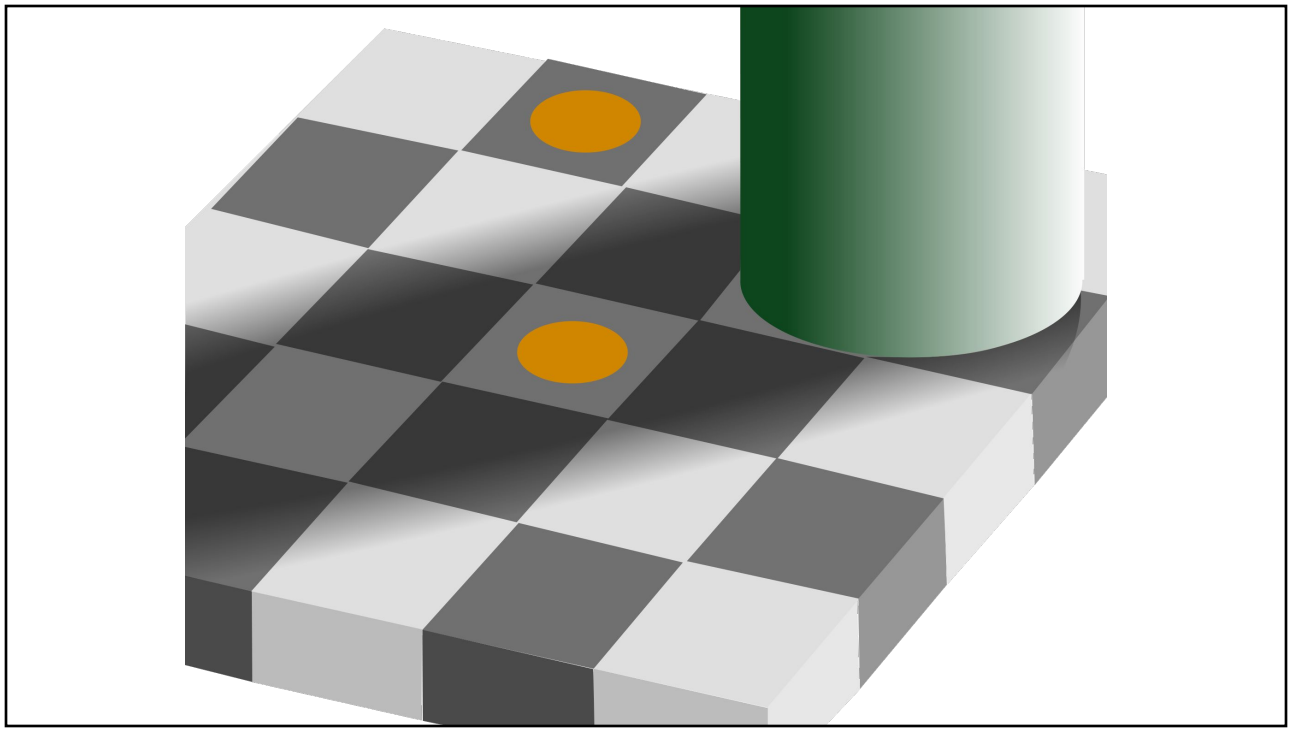
Perceptual Constancy:

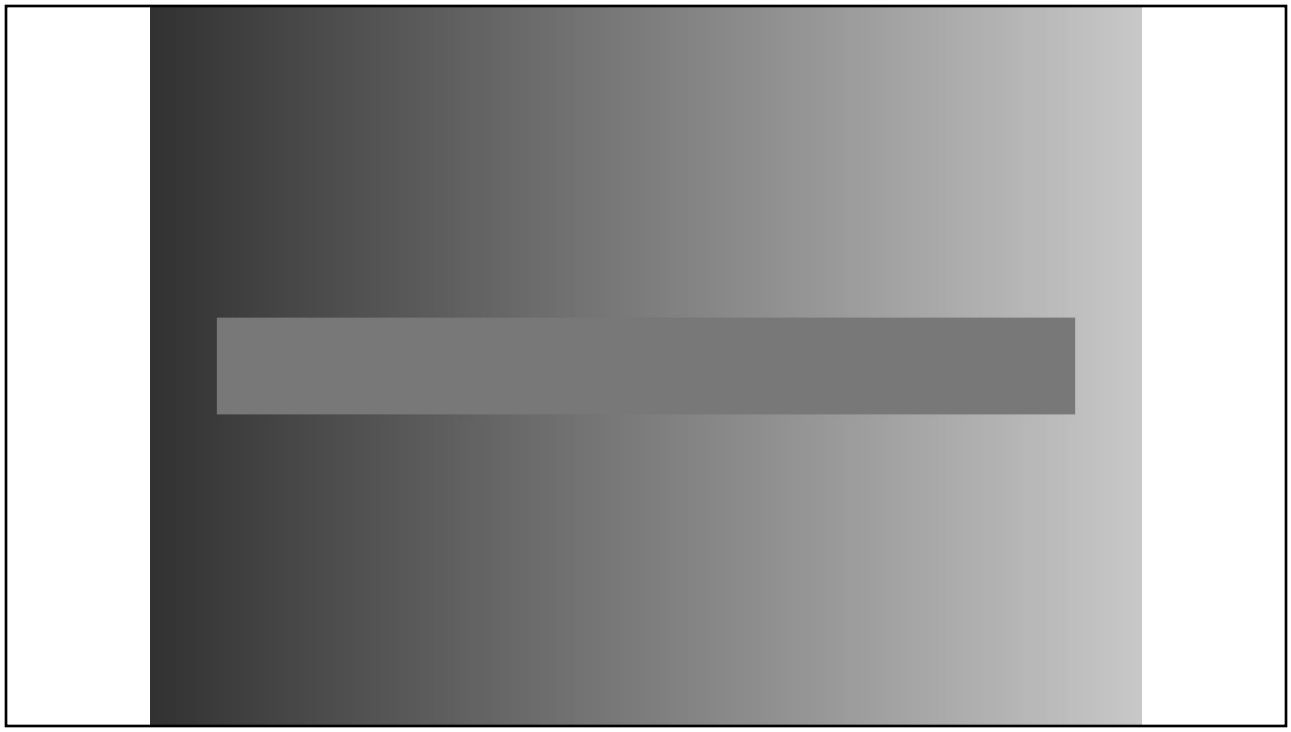
Perceptual Constancy: Perceiving objects as unchanging even as illumination and retinal images change.

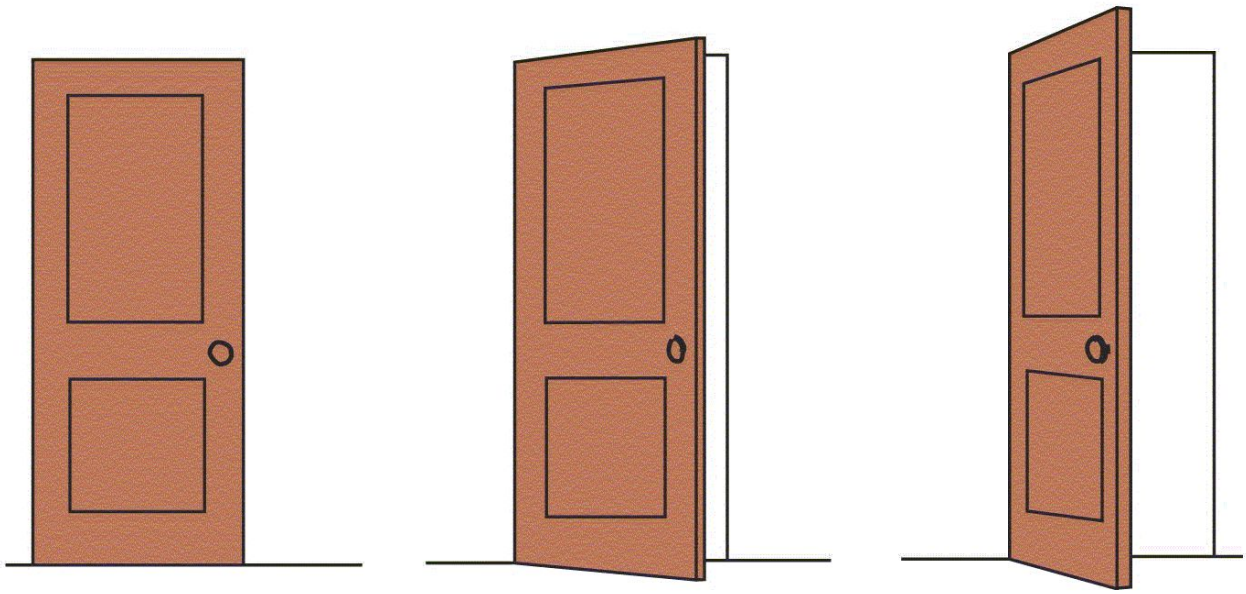
Color Constancy: perceiving familiar objects as having the same color even if lighting alters the coloration reflected by the object.

Shape Constancy: perceive the form of a familiar object as constant even if our retinas receive a changing image of the object (ex. door)

Size Constancy: perceive familiar objects has the same size even as distance changes







Perceptual Adaptation

Perceptual Adaptation (Vision): the ability to adjust to an artificially displaced or even inverted visual field.

If our vision becomes distorted, our brains begin to compensate for the distortion.


Die
Umkehrbrille
Die
Umkehrbrille
GMM

Vocabulary Activity 8.2A

Write a paragraph using the following terms to explain how vision works. Underline the terms in your paragraph as you use them.

1. Transduction
2. Lightwave
3. Cornea
4. Iris
5. Pupil
6. Lens
7. Retina
8. Cones
9. Rods
10. Optic Nerve
11. Occipital Lobe
12. Visual Cortex

The Non-Visual Senses

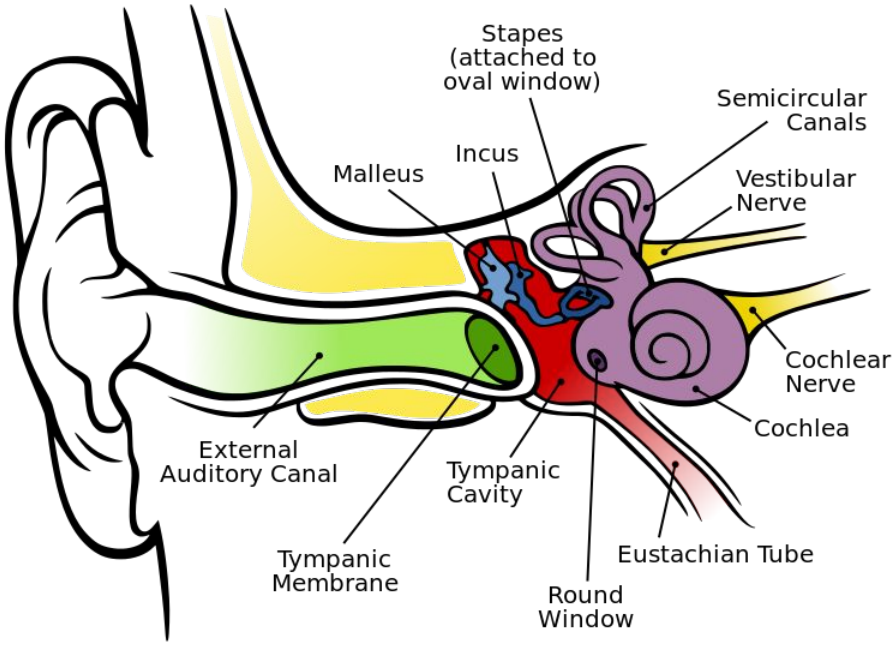
Hearing
Touch
Taste
Smell

Parts of the Ear:

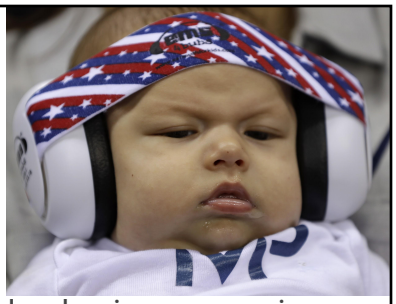
Ear Flap	Directs the sound waves towards the auditory canal (ear canal)
Auditory Canal	
Ear Drum (Tympanic Membrane)	
Hammer, Anvil, & Stirrup (Malleus, Incus, Stapes)	
Cochlea	
Basilar Membrane & Hair Cells of the Basilar Membrane	
Auditory Nerve	

Hearing:

- Sounds travel in waves
  - Amplitude (height) determines loudness
  - Frequency (wavelength) determines pitch
- The ear converts sound waves into vibrations and then into neural impulses which the brain can understand.
- The ear also aids in balance (vestibular sense)
  - Fluid in the inner ear helps make sense of body positioning
  - Changes to the fluid levels or sudden movement can result in a feeling of imbalance or vertigo (dizziness)



Hearing Loss



- **Sensorineural Hearing Loss**:
  - Also known as nerve deafness
  - Results from damage to the hair cell receptors
  - Usually caused by aging or prolonged exposure to loud noises or music
  - Cannot be treated or reversed once damage is permanent
  - **Tinnitus**: ringing in the ear caused by nerve damage
- **Conduction Hearing Loss**:
  - Caused by damage to the mechanical system that conducts sound waves to the cochlea
  - The **Cochlear Implant** can be used to bypass the damaged cochlea

Touch

- Touch results from sensory receptors in the skin that can sense:
  - Pressure
  - Cold
  - Warmth
  - Pain
- Other touch sensations are a result of combining the above four senses.
  - Example: cold + pressure = wet
- **Pain**: body's way of telling you there is something wrong
  - Pain is a result of the brain's interpretation of pressure sensors
  - In chronic pain, pain receptors will not "turn off"
  - Women tend to be more sensitive to pain
  - **Phantom Limb**: amputated limb still has "sensation"

Controlling Pain:

- Pain is a combination of physical and psychological sensation
- **Endorphins**: neurotransmitters that reduce the pain sensation
  - Some people produce more endorphins and are less responsive to pain
  - **Opioids** mimic endorphins to reduce pain sensation (ex. Morphine & Oxycodone)
- Pain can also be reduced through distraction
  - Diverting the brain's attention away from the pain
  - Ex. using 3D Goggles while undergoing wound care, or counting backwards
  - Hypnosis and Meditation have also been shown to reduce pain severity

Smell

- Chemicals enter the nasal passages and dissolve in the mucus membranes where the olfactory receptor cells are located
- Olfactory (smell) receptor cells are not triggered by a specific type of scent
  - 350 different types of olfactory receptor cells
  - Average human can distinguish between 10,000 different smells
- Smell is the only sense that does not link through the thalamus
  - The olfactory bulb is in the frontal lobe (the part of the brain that stores memories and senses emotions)
  - Sense of smell often closely tied to memories
- Smells can also influence emotions
  - In a foul smelling room, more likely to be cranky or critical than in a pleasing smelling room

Taste

- Tastebuds - where sensory receptors cells are connected on the tongue
- Taste Receptor Cells respond to the following tastes:
  - Sweet (energy source)
  - Salty (sodium is essential to biological process)
  - Sour (warns of potential food toxicity)
  - Bitter (wars of potential food poison)
  - Umami (savory - indicates proteins)
- Factors that affect taste:
  - Age
  - Smoking
  - Alcohol Consumption
  - Expectations
- Taste is closely linked to sight and smell