

Unit 8: Biodiversity

Content Outline: Sensory Mechanisms (8.10) – Part 1

I. Sensation of **Hearing**

A. This sensation is accomplished by mechanoreceptors located in the inner ear. (Sound is basically hairs bending.)

B. Structure of the human ear (

1. Outer Ear - This part is for the *collection of sound waves from the external surrounding environment*.

a. **Pinna** - This cartilaginous structure acts like an antenna *for collecting sound waves.*)

b. **Auditory canal** (This *concentrates the energy* as it moves toward the middle ear.)

c. **Tympanic Membrane** (A.K.A. ear drum) - This structure *converts* the sound wave energy into vibrations.

2. Middle Ear - This part is for the **amplification of energy** traveling toward the inner ear.

a. **Malleus** (A.K.A. the hammer)*

b. **Incus** (A.K.A. the anvil)*

*smallest bones in the human body

c. **Stapes** (A.K.A. the stirrup)*(This bone bangs on the oval window to *create ripples* inside the cochlea.)

i. These bones are responsible for amplifying the vibration energy.

d. **Eustachian tube** – These tubes, that connects with the throat, acts as a *pressure valve* for the ears.

e. **Oval window** (This structure *converts the amplified vibration energy* into fluid wave energy.)

3. Inner Ear -This part is where the transduction of fluid waves into electrical energy occurs – the type of energy that the brain can understand.

a. **Cochlea** “snail shell shaped” - This organ is located in the temporal bone of the skull.

i. It is filled with a fluid called perilymph. (This fluid is used to make ripples.)

ii. The **Vestibular Canal** runs on top of the Cochlear duct. (A “vestibule” is a covering.)

iii. The **Tympanic Canal** runs on the bottom of the Cochlear duct. It ends at the round window.

iv. The **Cochlear Duct** contains the **Organ of Corti** (Where the hairs are located.)

- **Basilar membrane** (This contains the mechanoreceptor hairs)

- **Tectorial Membrane** (This *bends the hairs* as the ripple energy passes over top.)

- *Hairs bend causing neurons of the auditory nerve to create an action potential. (Electrical energy).*

b. **Round Window** - This structure *absorbs the ripple* so as not to create waves in opposite direction.

C. **Volume** (A.K.A. loudness)

1. This term refers to the **sound wave height** – (Tall = *loud*); (Small = *soft*)

D. **Pitch** (A.K.A. Frequency) This term refers to the “*number*” of sound waves to hit the tympanic membrane per second.

1. It is measured in **hertz** (Hz) – (20 -20,000 – human hearing) Most animals can go much higher than humans.

Evolution? Humans have lost some hearing because of life style – blind people not so.

II. Sensation of **Balance and Motion**

A. These are accomplished by mechanoreceptors (hairs bending again) in the Inner Ear.

B. **Vestibule** - This is the covering of the **Utricule** and **Saccule** – These structures are perilymph reservoirs.

C. **Semi-circular canals** - There are 3 on each side of head. These are the actual organs that detect these sensations.

1. The canals are filled with perilymph fluid.

2.3 canals: (90° -detects up/down; 45° - detects horizontal/vertical; 0° -detects left lean/right lean)

3. **Ampulla** - This is the swelling located at the end of a canal. This swelling contains the cupula.

4. **Cupula** – This structure contains the embedded mechanoreceptors (Hairs that bend.)

a. Movement of the body causes the perilymph to “flow” through the canals and bend the cupula hairs.

b. *Cupula bends hairs causing depolarization in neurons and the energy of motion is converted to electrical energy.*

III. Sensation of **Taste**

A. This is accomplished using receptors in the nose (**olfactory** – means “smell”) and mouth. (**gustatory** – means “taste”)

B. Chemicals are detected by different neurons upon contact.

1. The five taste senses are: sweet, sour, bitter, salty, and umami (means “savory” ... applies to meat taste.)

Taste is 80 % SMELL and 20 % TASTE – What if you have a cold? Food seems tasteless.

Part 2

I. Sensation of **Sight** (The eyes are a collection of photoreceptors.)

A. Types of light detecting structures:

1. **Oscilli** – As seen in Cnidarians and Bi-valves.
2. **Eye cup** – As seen in Platyhelminthes.
3. **Eyes with a lens** as seen in most other animals.
 - a. **Compound Eye**– Found in invertebrates, such as insects.
 - i. Many **ommatidia** working together. (Produces multiple pictures of the same object.)
 - ii. This type of eye is great for detecting movement.
 - b. **Single Eye**– Found mollusks and vertebrates. (These are good for detecting definition.)

B. Anatomy (structure) of the Human Eye:

1. **Sclera** – This is referred to as the eye white.
2. **Choroid** – This layer contains the blood vessels and black pigment for reducing sun light glare.
3. **Conjunctiva** – This layer is involved with mucous production to keep the eye cells moist. (**Conjunctivitis**... is the *inflammation* of this tissue layer.)
4. **Cornea** – This layer is the clear part of the sclera. (It also acts as a fixed lens.) (Prevents debris from entering.)
5. **Iris** – This is the “colored” choroid (It controls the amount of light entering the eye through the pupil.)
 - a. It is operated by smooth muscle automatically for you. (Autonomic nervous system.)
6. **Retina** – This layer of the eye is the site of the photoreceptors.(It appears yellow upon dissection.)
 - a. **Rods** - This receptor cells are for seeing black, white, and shades of grey.
 - i. They are the most abundant in all animals having these structures..
 - ii. They possess **Rhodopsin Pigment**.
 - b. **Cones** - These receptor cells are used for seeing color.
 - i. They are outnumbered 20 :1 by the rods.
 - ii. They are found in vertebrates: but not all.
 - iii. They possess **Photopsin Pigments** (red, blue, green) (Color-blindness –sex linked recess.)
(The genes for making these pigments were never in the parents gametes.)
7. **Lens** – This structure focuses light. (It is made of a transparent, stretchable protein called crystalline.)
 - a. **Accommodation** (This is the “focusing” of the eye for near vs. distant vision... This requires it to stretch.)
 - i. **Stigmatism** – This term refers to a misshaped lens.
 - ii. **Myopia** – (A.K.A. nearsighted) (You can’t see far away objects clearly.)
 - iii. **Hyperopia** – (A.K.A. farsighted) (You can’t see close up objects clearly.)
 - iv. **Presbyopia** – Term refers to lens degeneration associated with old age.
 - v. **Cataract** – This term refers to a “cloudy lens”.
 - vi. **Glaucoma** – Condition of having too much vitreous humor; results in too much pressure in the eye.)
8. **Ciliary Body** – These are the muscles that stretch the lens.
9. **Aqueous Humor** – This is the fluid in the **front** of the eye. (It is mostly water... “aqueous”; humor means “fluid”.)
10. **Vitreous Humor** – This is the fluid in the **back** of the eye (It is jelly-like... “vitreous”) (It gives the eye its shape.)
12. **Optic Nerve** – There is one for each eye. (It takes the action potential to the brain.)
13. **Optic Chiasm** – Collects rights and lefts in to one side of brain. (Located in the base of the brain.)
14. **Lateral Geniculate Nuclei** – These groups of neurons make the right or left “side” picture.
15. **Primary Visual Cortex** of the Occipital lobe of cerebrum - The site of integration of “halves” into 1 picture.

Part 3

I. **Locomotion** – (A.K.A movement) This term refers to *active* movement of an organism or object.

A. This process is the *second largest consumer of ATP* energy within an organism because:

1. Organism has to overcome the *force of gravity* AND
2. Overcoming the *force of friction* (resistance).

B. It is accomplished by the use of muscle tissue working with the bones.

C. Types of environments dealing with locomotion:

1. Water (Organisms are swimming or floating.)
 - a. *Little* gravity to overcome because of buoyancy; but *much* friction (water resistance).
 - i. Having a **fusiform** (means “torpedo shaped”) body lessens friction.
2. Land (Organisms are standing/walking/running.)
 - a. *Much* gravity to overcome; but *little* friction (air resistance).
 - i. Organisms have strong muscular limbs to overcome gravity.
3. Air (Organisms are flying or gliding.)
 - a. *Much* gravity to overcome and *much* friction to overcome (air resistance).
 - i. These require massive amounts of energy be consumed to overcome.