

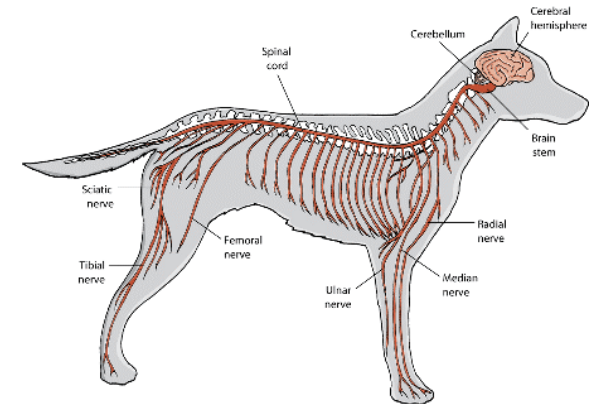
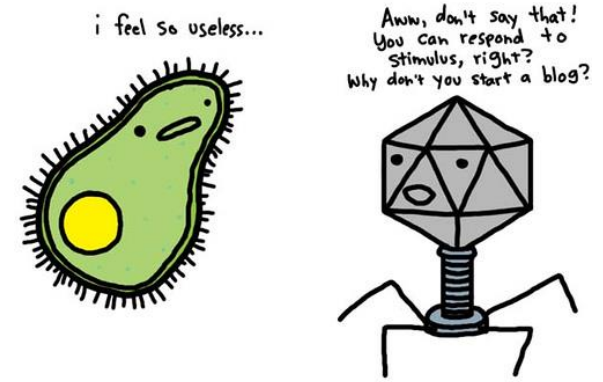
Sensory Systems

Zoology 306L

TA: Nate Wehr

Stimuli and Behavior

- What is a stimulus (plural stimuli)?
 - Anything that evokes a reaction from an organism
 - Something that acts upon the sensory neurons of the animal
 - Positive or negative influences
- Internal vs External stimuli
 - External
 - Sights, sounds, smells, tastes, vibrations, touches, electrical signals, magnetic fields, heat and cold, pain, etc.
 - Internal
 - Hunger, thirst, body temperature, hormones, etc.
- Peripheral vs Central Nervous System (PNS vs CNS)
 - CNS
 - Spinal cord and brain – major sensory integration and decision making area
 - PNS
 - All nerves outside of brain and spinal cord – sensory and motor (and interneurons)
- Motor neurons
 - Carry impulses away from the CNS to perform actions: either controlled or reflexes
 - Acts upon the stimulus in a way that is potentially beneficial to the organism, otherwise organism dies and genes are lost
- **All** behaviors are evoked by a stimulus, even yours! - Psychology

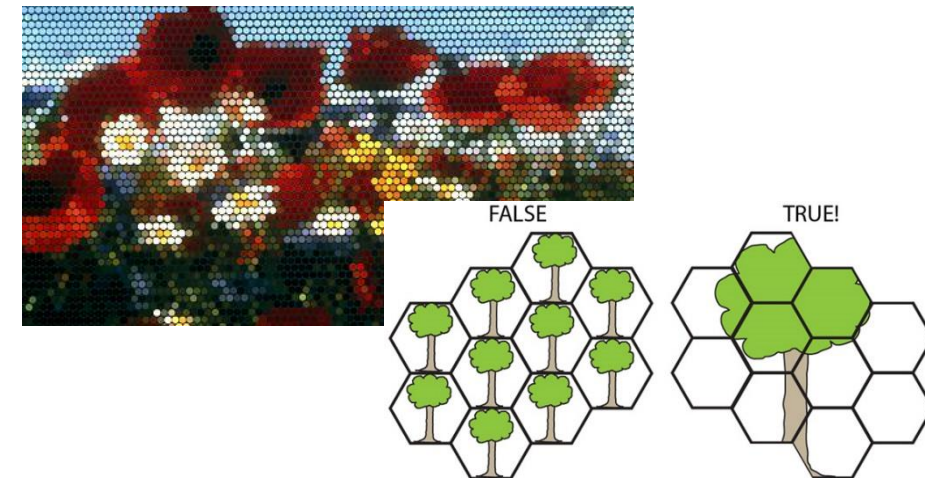
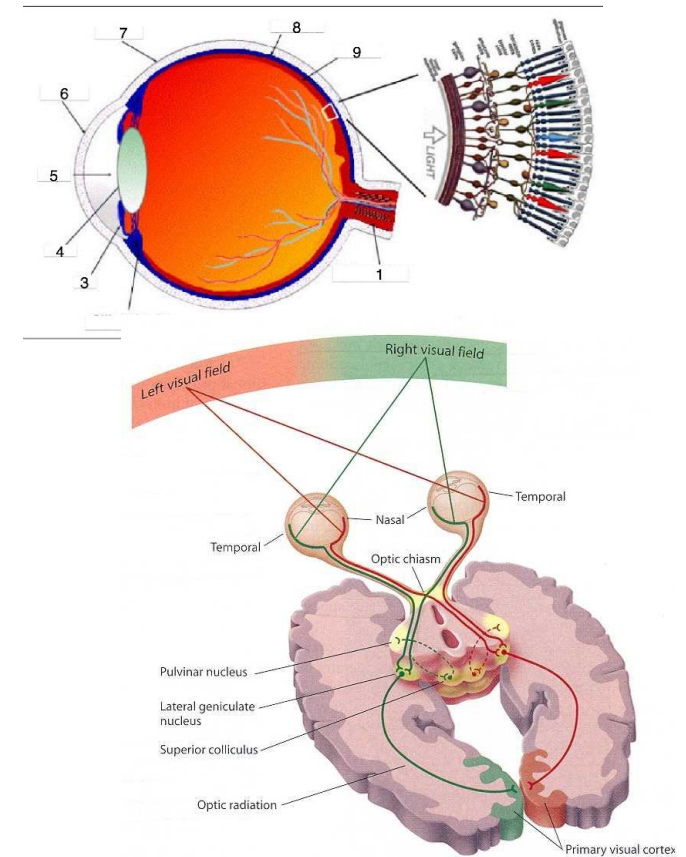


Behavior is based on Neurons

- All behavior is a result of stimuli affecting the brain and the brain affecting the body in a way that addresses the stimulus
- Receptor cells in each sensory system create signals that are sent via neurons
- Watch the following 10 min video:
 - https://youtu.be/qPix_X-9t7E
- Crash Course made by Hank Green covers many, MANY topics in quick, easy to understand, fun, and surprisingly in-depth videos on Youtube. They are all free. You are welcome.

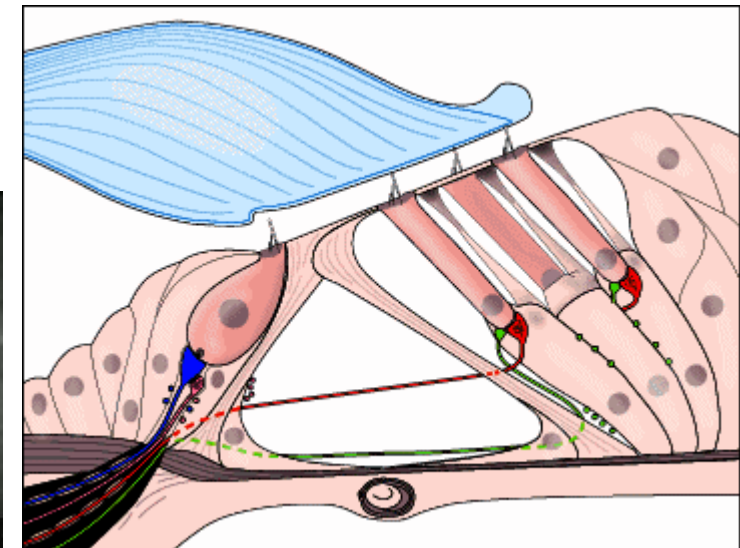
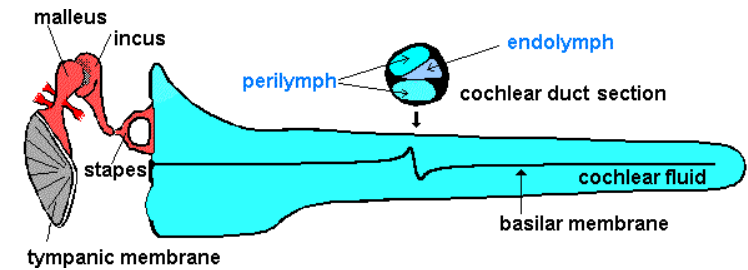
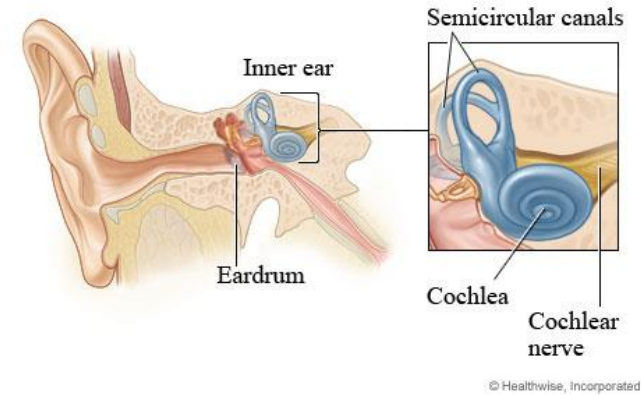
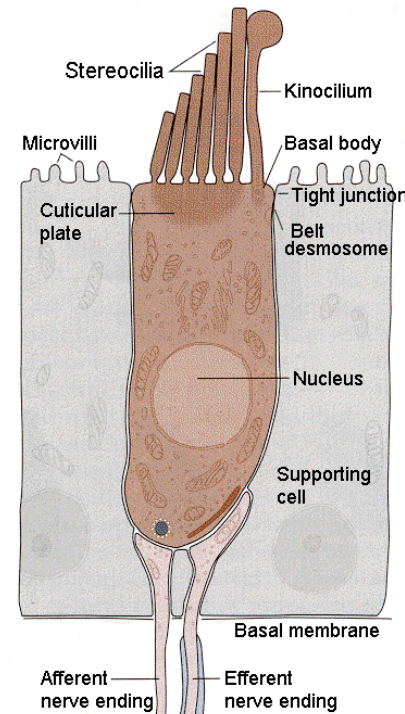
Types of Sensory Systems: Visual

- Visual (sight)
 - Photoreceptors: light hits rhodopsin, causes excitation, signal is sent to brain via optic nerve (nerve is large bundle of axons)
 - VERTEBRATES: whole system is a bit backward
 - Light enters eye, passes all the way through many cell layers to hit photoreceptors
 - This leads to blind spot
 - Blind spot demonstration
<http://pbskids.org/zoom/activities/sci/blindspot.html>
 - Optic chiasma – to the opposite side of the brain
 - Image is inverted by lens, brain works to right it
 - Rods and Cones: light/dark vs color/acuity
 - Fovea: highest concentration of cones
 - INVERTEBRATES
 - Image not inverted by ommatidia, each acts as its own, very focused eye



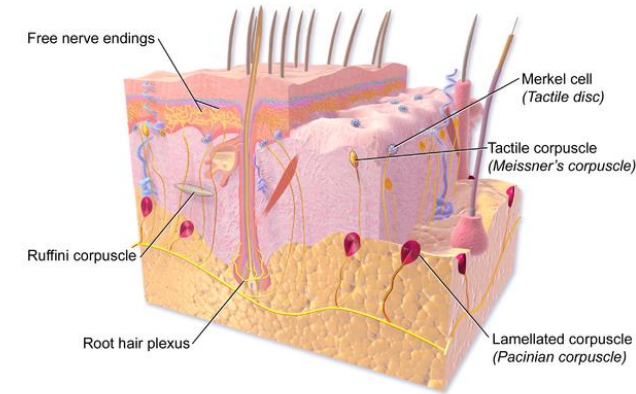
Types of Sensory Systems: Auditory

- Auditory (hearing)
 - Hair cells – NOT mammal *hair* --->
 - Movement of air = movement of bone = movement of fluid = movement of hair cell = generation of electric signal
- Three chambers within cochlea
 - Scala Vestibuli and Scala Tympani: responsible for ion maintenance in fluid
 - Scala Media: contains Organ of Corti on the Basilar membrane
- Sound also exists underwater
 - Fish hearing similar, but no cochlea

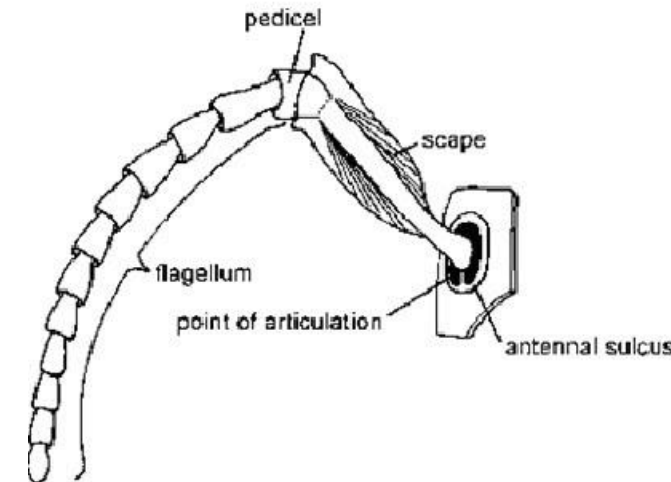


Types of Sensory Systems: Mechanosensory

- Mechanosensory (touch, lateral line)
- Some (not all) touch receptors in vertebrates
 - Tactile corpuscles: respond to light touch, responsible for detection of texture
 - Bulbus corpuscles: detect tension in skin and muscle
 - Merkel nerve endings: detect sustained pressure
 - Lammellar corpuscles: detect rapid vibrations in the skin or muscles
 - Hair follicle receptors: detect movements of hairs – whiskers
- Antennae touch reception
 - Hair sensilla: found on flagellum surface, single mechanoreceptor housed in a hair; detect deflection of the hairs
 - Campaniform sensilla: no hairs, located between pedicel and flagellum; detect stress, tension, and movement of flagellum
 - Chordotonal sensilla: internal mechanoreceptors; Johnston's organ = sensitive to vibration

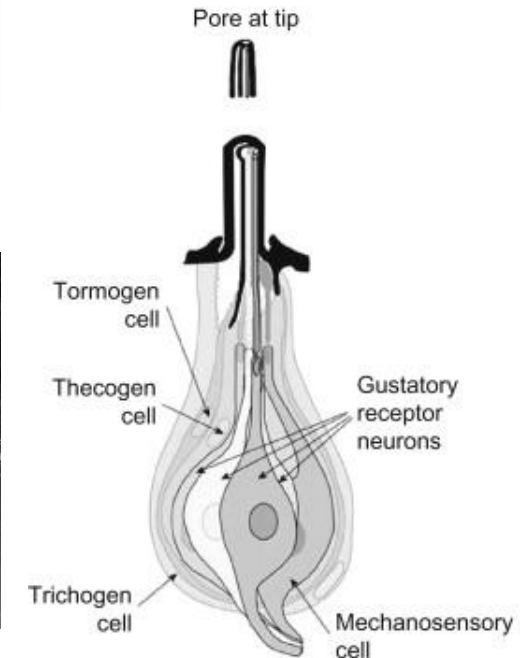
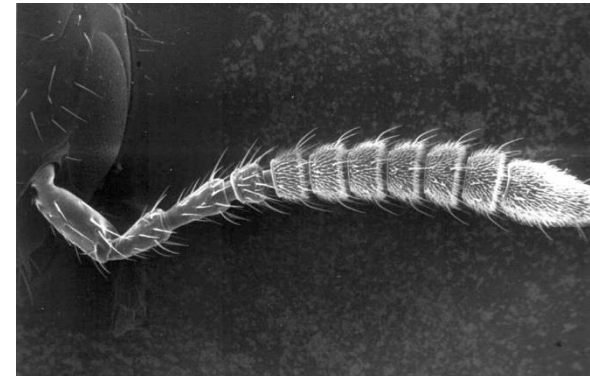
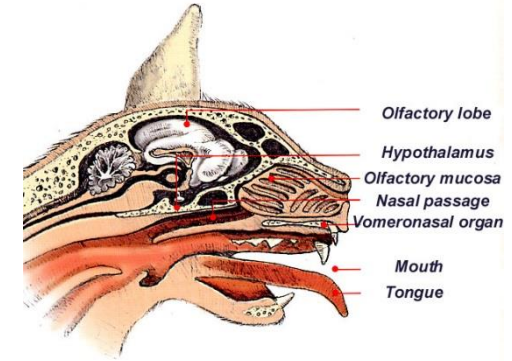
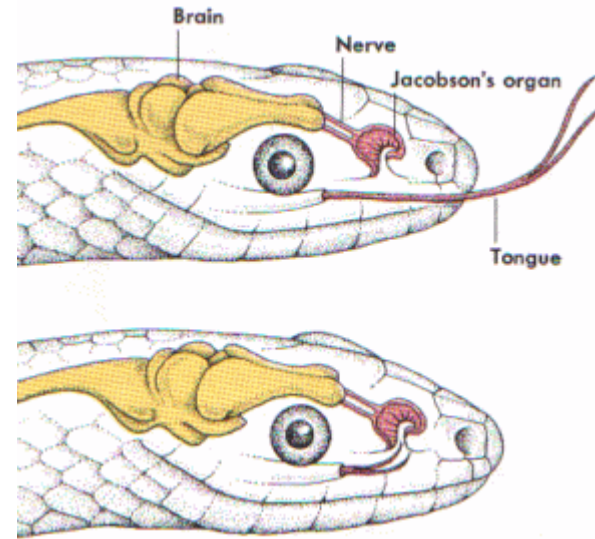


Tactile Receptors in the Skin



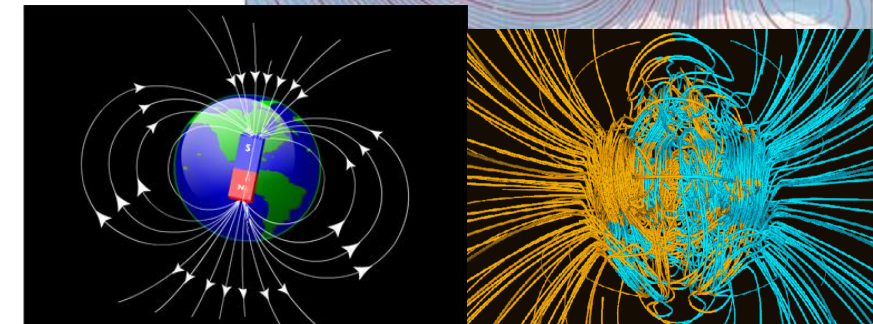
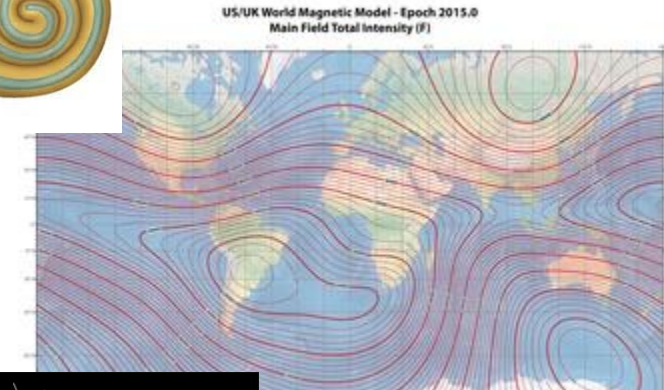
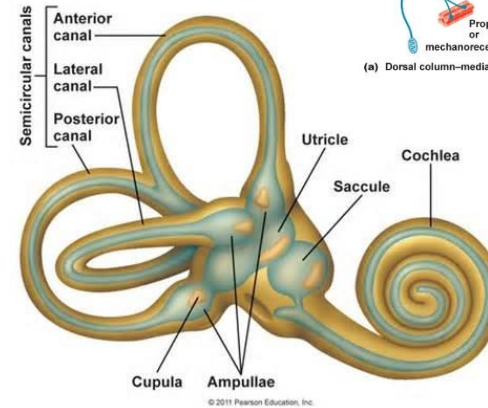
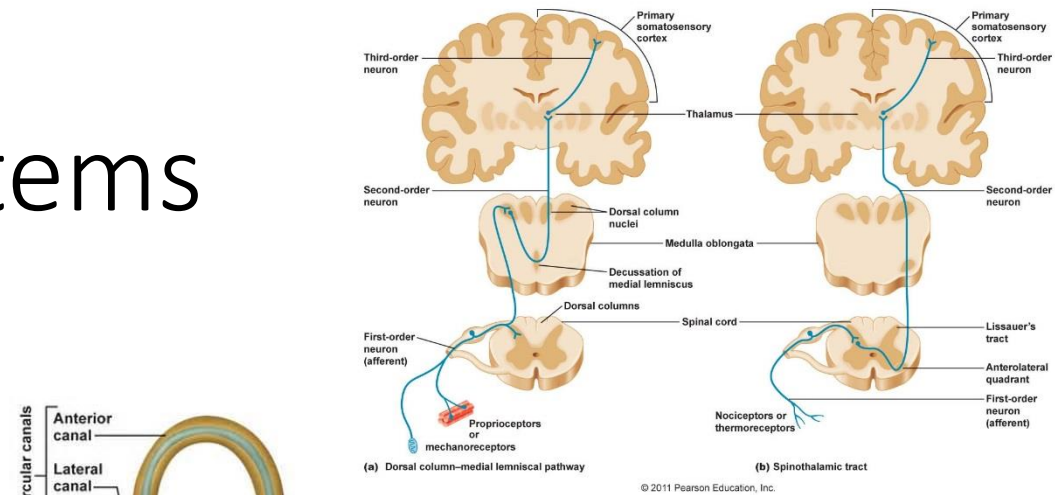
Types of Sensory Systems: Chemosensory

- Chemosensory (smell and taste)
- Vertebrates
 - Taste buds (sour, sweet, bitter, salt, umami)
 - Smell: all smells contain molecules that bind to receptors in the nose
 - Combination of smell and taste – Jacobson's organ/ vomeronasal organ
- Invertebrates
 - Antennae also detects chemicals, not just touch
 - Each Hair sensilla has a pore at the end and multiple chemical receptors surrounding the one mechanoreceptor



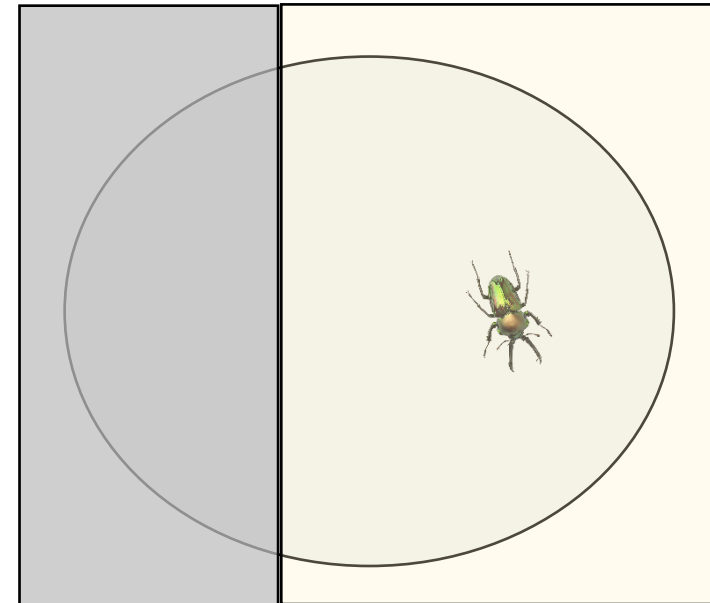
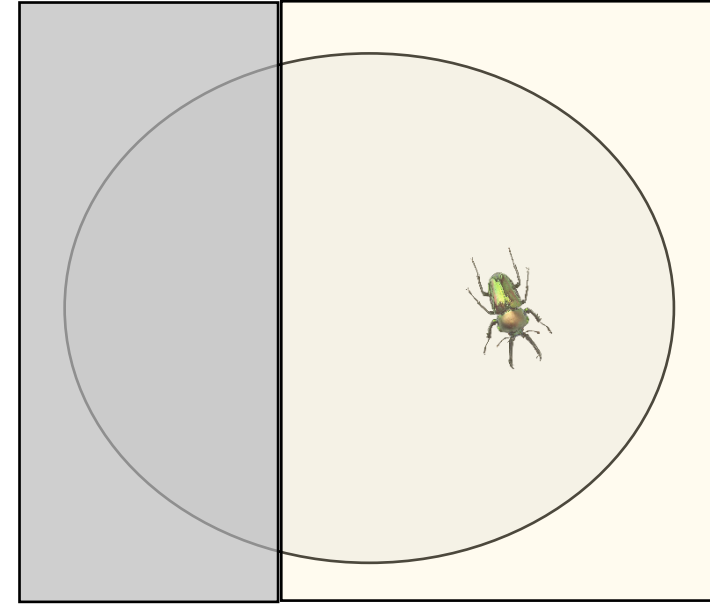
More Types of Sensory Systems

- Nociception (pain and temperature)
 - Travels up opposite side of spinal cord from touch
 - Why advil, Tylenol, and alieve work: different receptors and pathways from touch
- Vestibular (balance/ gravity)
 - Semicircular canals of inner ear
 - Movement of fluid affects hair cells – tells you orientation of head
 - Anything that messes with the fluid movement or consistency messes with balance/ makes you dizzy
- Electoreception (electric pulses or waves)
 - Sharks, electric fish, crocodiles, and platypus
 - Pits on the face or body that are sensitive to voltage
- Magnetoreception (magnetic fields)
 - Often mechanism unknown. Birds have magnetite crystals in special cells in their noses and ears. Can feel differences in earth's natural magnetic field



Taxis and Kinesis

- Taxis is the movement of an animal toward or away from a stimulus
- Positive taxis = movement toward stimulus
- Negative taxis = movement away from stimulus
- Many types of taxis:
 - Chemotaxis = towards or away from a taste or smell
 - Phonotaxis = towards or away from a sound
 - Phototaxis = towards or away from light
- Kinesis is a non-directional change in movement patterns in response to a stimulus
 - Kinesis common in very simple organisms
 - Example: animal that can only see light or absence of light will run randomly when exposed to light. Runs until it can no longer detect light, but does not set out with destination in mind ---->



Communication

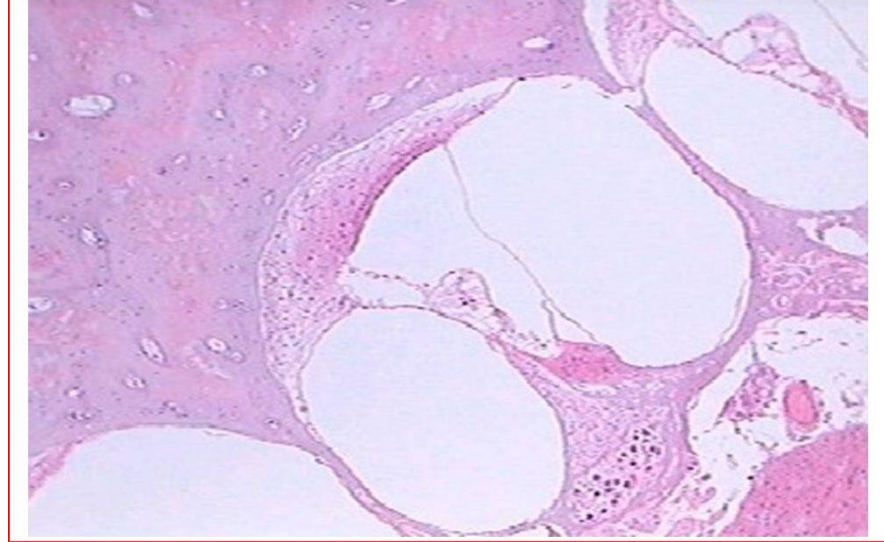
- Many ways for animals to communicate
 - Vocal signals
 - Visual signals: body posture, movement pattern, coloration
 - Chemical signals: smells, pheromones, tastes
 - Mechanical signals: vibrations, touch, sting, bite, tail whip
 - Electrical signals: more next week!!
- Communication vs Cues
 - True communication uses signals: intentional sensory information from a sender to an intended receiver – benefits sender and receiver
 - You benefit from leaving rattlesnake alone and snake does not have to waste venom or get into a dangerous fight
 - Cues are unintentional sensory information from a sender – benefits receiver only
 - Rattlesnake can sense heat coming off of field mouse's body. Mouse does not mean to give off heat, it is product of metabolism.



Today's lab

- Each activity = 30 minutes
- Groups of 4 – 3 total stations, one group per station and rotations
- STATION 1: Slides. Draw what you see on the slides in your notebook. Label thoroughly.
 - Answer the questions in lab manual in your notebooks!
 - Cochlea slides very, tough see picture →
- STATION 2: Termites. Use the gentle tweezers when moving termites. Determine soldier vs worker. Do NOT let any escape. Place used termites in cup to avoid pseudoreplication.
- STATION 3: Maggots. Use gentle tweezers when moving maggots. Determine age of maggot. Only use healthy maggots.

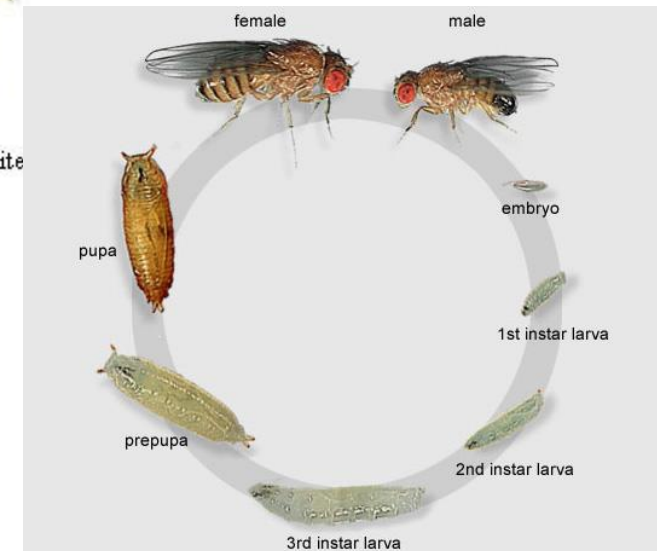
Spiral Organ of Corti - Slide Box 620 - Guinea Pig Cochlea



Worker Termite



Soldier Termite



Homework

- One lab report, two sections: chemotaxis and phototaxis
- Everyone should have started collecting data for your projects this past week, continue collecting data outside of class
- DO NOT leave data collection to last minute! It gets messy!