BIO 264L Anatomy & Physiology

MODULE 10: SPECIAL SENSES

An Introduction to the Anatomy of the Eye and the Ear

The special senses include vision, hearing, smell and taste. However, this lab will cover only the foundational anatomy of the eye and the ear.

LIST OF TERMS FOR THE ANATOMY OF THE EYE AND THE EAR	
EYE	
Accessory Structures • **Eyebrows** • **Palpebrae** • **Palpebral Fissure** • **Caruncle** • **Eyelashes** • **Conjunctiva**	**Palpebrae** comes from ancient Latin and refers to the eyelid and blinking or winking. The **caruncle** is a small red triangular portion of the inferior medial corner of the eye. This structure contains modified sebaceous and sweat glands that produce material that helps lubricate the eye. The **conjunctiva** is a thin moist membrane that lines the inside of the eyelids and also covers the sclera. The cells that make up the conjunctiva secrete an aqueous substance that contains mucus and water. The conjunctiva is also important for lubricating the eye. You may have heard the term "pink eye" before. Generally this is referring to inflammation of the conjunctiva often caused by an infection.
Lacrimal Structures • **Lacrimal Gland** • **Lacrimal Canaliculi** • **Lacrimal Sac** • **Nasolacrimal Duct**	The **lacrimal structures** of the eye are structures that participate in the production and drainage of tears. The lacrimal gland produces the tears. The Lacrimal canaliculi, lacrimal sac and Nasolacrimal duct convey the tears away into the cavity of the nose. Have you ever noticed that if you were crying and weeping very hard or long that you got a runny nose. You can blame the lacrimal structures for that.
Extrinsic Eye Muscles • **Superior Rectus** • **Inferior Rectus** • **Medial Rectus** • **Lateral Rectus** • **Superior Oblique** • **Inferior Oblique**	The skeletal muscles called extrinsic eye muscles are under reflexive and voluntary control. Together they rotate the eye in its socket up / down; side to side; and can even cause the eye to spin. One particularly interesting feature is the fact that the **superior oblique** sends a tendon through a kind of "pulley" attachment in the upper medial part of the eye socket. This turns the direction of pull for this muscle and helps it spin the eye in a way that it is possible to look down towards the mouth.

Eye Cavities • **Anterior Chamber** • **Posterior Chamber** • **Aqueous Humor** • **Vitreous Chamber** • **Vitreous Humor**	The eye has three spaces that we refer to as chambers. The **anterior chamber** is found between the iris and the cornea. The **posterior chamber** is the space anterior to the suspensor ligaments and lens but posterior or "behind" the iris. In reality the anterior and posterior chambers are connected and the fluid in these chambers is the same fluid. It is called the **aqueous humor**. Aqueous refers to the watery nature of the fluid. The fluid in the vitrious chamber is much more viscous. The **vitreous chamber** is a large cavity that makes up the majority of the "eye ball". The vitreous chamber exists behind the lens and anterior to the retina. The **vitreous humor** is the fluid in the vitreous chamber and is not watery but more gel like.
Fibrous Tunic • **Sclera** • **Cornea**	Tunic refers to garment or layer. The eye has three main layers. The **fibrous tunic** is the outermost layer and contains the sclera and cornea both made of fibrous connective tissue. The vascular tunic is deep to the fibrous tunic and the Nervous tunic is the deepest layer and is in contact with the fluids inside the eye. The **sclera** is a fibrous connective tissue layer that is found on the external eyeball. When you hear the phrase "don't shoot until you see the whites of their eyes", the whites of their eyes is referring to the sclera. The **cornea** is a thin transparent covering over the iris and pupil.
Vascular Tunic • **Choroid** • **Ciliary Body** ➢ **Ciliary Muscles** ➢ **Suspensory Ligaments** • • **Iris** • **Lens** • **Pupil**	The **vascular tunic** is the middle layer of the eye. It is generally accepted that there are three parts to the vascular tunic, the choroid, ciliary body and the choroid. The lens and pupil are not directly part of the vascular tunic but we will consider these structures as being associated with the vascular tunic. The **choroid** is a vascular layer of the eye, so we find blood vessels in the choroid. The choroid also contains pigment that makes this layer dark. The dark color of the choroid helps keep light from reflecting around the globe of the eye. This makes vision sharper. FYI: the posterior part of the choroid in many animals contains pigments that give the choroid an iridescent appearance. You may have noticed this if you shined your headlights onto a dog and noticed that the eyes seemed to "glow" The **iris** is a thin circular structure composed mostly of connective tissue and smooth muscle fibers. This structure controls the diameter of the pupil through relaxation and contraction of the muscle fibers. This structure is also highly pigmented which gives rise the many colors of human eyes. The **lens** is a connective tissue structure that is oval shaped (thicker in the center then the edges). The **ciliary body** which is comprised of **ciliary muscle** tissue and **suspensory ligaments** controls the shape of the lens. The regulation of the shape of the lens helps bend light in a way that we can focus on things we are looking at. The **pupil** is not really a structure it is a hole. The pupil is the opening on the anterior eye that allows light to hit the lens.

Nervous Tunic (Retina)

- **Ora Serrata**
- **Macula Lutea**
- **Central Fovea (fovea centralis)**
- **Optic Disk**
- **Optic Nerve**

We generally refer to the nervous tunic as the **retina**. The retina contains several specific regions.

The **ora serrata** is a “serrated” edge that marks the boundary between the retina and the ciliary body.

The **macula lutea** is an oval shaped kind of yellow pigmented spot near the center of the posterior retina. The macaula lutea has a particularly high density of photoreceptors and is an area that we should focus light if we want to see greater detail. Also, because the lutea is yellow, it absorbs a lot of blue and ultraviolet light. This helps us see more clearly in bright sunlight. Finally, near the center of the macula lutea is a small pit called the **fovea centralis or central fovea**. This area contains the largest concentration of photosreceptors and light focused here will provide us with the most detailed sight of the thing we are looking at. For example we would want to focus the light coming from anything we read on the fovea to have the sharpes focus of the letters.

The **optic disk** is a yellow circular area on the posterior retina. This disk represents the convergence of neurons leaving the retina and entering the optic nerve. This particular location on the retina does not have photoreceptors and so light focused here will not be seen. This is called the “blind spot”.

The **optic nerve** is the structure that contains the neurons leaving the retina and coursing towards the brain. The optic nerve courses from the back or posterior of the eye to the optic chiasma.

EAR

External (Outer) Ear

- **Pinna (Auricle)**
- **Lobule**
- **Tragus**
- **External Auditory (Acoustic) Meatus**
- **Tympanic Membrane (Eardrum)**

The **external ear** refers to all the ear structures that can be seen on the lateral head as well as the ear canal and ear drum which can't be seen but are located inside the skull. The **pinna or auricle** is what we would traditionally call an "ear". It is the cartilage and skin that forms the structure of the external ear. The **lobule** is the ear lobe and the **tragus** is the cartilage projection just opposite and a bit superior from the ear lobe. The **external auditory meatus or acoustic meatus** (meatus is another word for canal) is the canal that one would put a Q-tip in to clean the ear *(not a good idea by the way and highly discouraged by those who treat the ear)*. The tympanic membrane or eardrum is a thin membrane at the end of the acoustic meatus and it vibrates when sound waves hit it.

Middle Ear (Tympanic Cavity)

- **Eustachian (Auditory) Tube**
- **Auditory Ossicles (Ear Bones)**
  - **Malleus**
  - **Incus**
  - **Stapes**
- **Tensor Tympani Muscle**
- **Stapedius Muscle**
- **Fenestra Vestibuli (Oval Window)**
- **Fenestra Cochlea (Round Window)**

The **middle ear** starts at the tympanic membrane and ends at the cochlea. The middle ear contains the **ossicles or ear bones**. The **stapes** of the middle ear connects to the **oval window** of the cochlea which is in the inner ear. The middle ear also contains a couple of muscles, the **tensor tympani muscle** and the **stapedius muscle** which can contract and reduce vibrations through the ossicles. This helps decrease the intensity of sound waves enterig the cochlea. The **round window** is covered with an elastic membrane that can absorb the sound waves after they have traveled through the cochlea.

Internal (Inner) Ear

- **Cochlea**
  - **Scala Vestibuli**
  - **Vestibular Membrane**
  - **Scala Tympani**
  - **Scala Media (Cochlear Duct)**
- **Organ of Corti (Spiral Organ)**
  - **Basilar Membrane**
  - **Tectorial Membrane**
  - **Hair Cells**
- **Vestibulocochlear (Auditory) Nerve**
- **Semicircular Canals**
  - **Lateral Semicircular Canal**
  - **Superior Semicircular Canal**
  - **Posterior Semicircular Canal**
  - **Ampullae**

The **inner ear** contains the cochlea, vestibulocochlear (auditory) nerve and the semicircular canals. The **cochlea** receives vibrations from the ossicles and transforms them into electrical signals. The sound waves travel in the **scala vestibule and scala tympani** and vibrate the **basilar membrane**. As the basilar membrane vibrates up and down, the **hair cells** are bent which depolarizes them and causes action potentials to occur in the **vestibulochochlear (auditory) nerve**. The **organ of corti or spiral organ** is really part of the cochlea but the online atlas does not have a third level of pull down menu so it is listed here as its own structure. The **semicircular canals** are positioned more or less in the three cardinal planes (frontal, sagittal and transverse). This how they can sense movement in in any direction. They are important for balance.