The Anatomy of Sea Turtles

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Chemical, visual, acoustic, and vestibular senses of sea turtles are concentrated in the head.

The tongue (Fig. 209) is a muscular organ covered by a mucous membrane. Taste buds are present but are poorly characterized. The tongue lacks obvious lymphoid tissue at its posterior, as is seen in mammals.

The nose includes external nares leading to an olfactory (nasal) sacs. The olfactory sac communicates via the nasopharyngeal duct to the internal choanae (internal nares; Figs. 195 and 210). The olfactory sacs and choanal folds are covered with a ciliated sensory epithelium. The olfactory epithelium, located posterodorsally in the nasal cavity, is innervated by the olfactory nerve leading to the olfactory bulb (Figs. 189, 193-201). The vomeronasal organ (Jacobson's organ) of turtles is not typical in its structure. This specialized sense organ, usually associated with detection of airborne and substrate-borne odor molecules, is not recessed in a separate pit as in snakes and some lizards. It is widely distributed anterolaterally and ventrally in the olfactory sac. The vomeronasal organ is distinguished from olfactory epithelium by region and histological characteristics rather than gross appearance. It is innervated by nerves running to

Fig. 209. Dorsal view of the tongue of the Kemp's ridley. The tongue is muscular and attached to the floor of the mouth. The surface is grossly smooth. The epithelium is covered in small, short, flat papillae.

Fig. 210. The sense organs of a green turtle. The nares lead to large pigmented olfactory sacks. There are several choanal folds on the walls of the olfactory sac, which lack bony supports. The olfactory sac leads, via the nasopharyngeal duct to the internal choanae. The olfactory nerve is cut in this dissection and has fallen ventrally. The inner cavity is cut ventral to the brain; the cochlea is also cut and part is exposed at the ends of the inner ear pointers. The middle ear is located more laterally and hence is not seen in this view.
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the accessory olfactory bulb (effectively the dorsal part of what is grossly called the olfactory bulb).

A series of small spike-like papillae line the lateral margin of the internal choane in *C. mydas*. These papillae are absent or poorly developed in other species.

The anterior tissue lining the nares is highly vascular and erectile in adult sea turtles. It appears not to have a sensory function but instead has the ability to seal the nostrils when the turtles are submerged.

The eyes of sea turtles are round and housed in bony orbits. The eye is protected by dorsal and ventral lids. The ventral lid is continuous with the conjunctiva, which forms its inner surface. The nictitating membrane, at the anterior and ventral corner of the eye, also is continuous with the conjunctiva (Figs. 198-200).

Figs. 211a and 211b. Eye and lids of a loggerhead. The eyes are located dorsally and anterolaterally. They have overlapping fields of view (hence, binocular vision). The dorsal and ventral lids are keratinized and mobile. The secondary lid is also keratinized but not mobile. The cornea, not labeled, is a clear portion of the sclera that overlies the iris and pupil. Palpebral scales are found in the margins of the ventral lid in cheloniids, but not in Dermochelys.
Figs. 212a and 212b. Leatherback eye. The lids of the leatherback eyes are positioned as more anterior and posterior lids than dorsal and ventral lids.
Fig. 213. Leatherback eye dissection. The lids of this leatherback eye were removed to show the extent and position of the nictitating membrane.
The wall of the eye (or globe) is composed of 3 major layers: the **sclera**, **uvea**, and **retina**, surrounding the viscous **vitreous body**. The eye is supported medially by cartilage and laterally by **scleral ossicles** (Figs. 82-84). The outer-most layer is the **sclera**. The eye muscles attach to the sclera (Figs. 215-216). The **superior oblique muscle** inserts dorsally and it is innervated by the **trochlear nerve**. The **superior rectus** muscle attaches posteriorly. Ventral to these muscles is the attachment of the **internal rectus** muscle. Anteriorly, the **pyramidalis** muscle extends from the eye to the eyelids and nictitating membrane. Deep and ventral to the pyramidalis muscle are the **inferior oblique** and **inferior rectus** muscles. The **external rectus** muscle is located posteriorly and ventrally and is innervated by the **abducens nerve**. The superior rectus, inferior rectus, inferior oblique and internal rectus muscles are all innervated by the **oculomotor nerve**.

**Fig. 214.** Sagittal section of a loggerhead eye. The eye is cut into medial and lateral halves. The retina and back of the eye are on the left. The inside of the iris, lens, and pupil are in the middle of the photo. Part of the vitreous body was removed and placed on the right.

**Fig. 215.** Lateral view of a loggerhead left eye. The extrinsic eye muscles are extended radially in this picture to show their relative insertion points. Normally their origins would converge on the interorbital septum.
The sclera, often termed the "white of the eye" in vertebrates, is partially pigmented in most sea turtles. The sclera is clear at the front of the eye; there it is termed the **cornea**. Internal to the sclera is the uvea, composed of the **choroid**, **tapetum lucidum**, **ciliary body**, and the **iris** (Fig. 199). The choroid is pigmented and extends from the iris to the retina. It includes the reflective material (tapetum lucidum) that is responsible for "eye-shine". The reflective material enhances the eye's sensitivity under low light conditions. The ciliary body (not shown), is responsible for changing lens shape during visual accommodation. It extends from the choroid near the front of the eye, to the attachments that suspend the lens. The iris is pigmented brown or black and extends from the choroid across the front of the eye. The **limbus** (= limbas) is the tissue between the cornea and the sclera. Because the cornea and sclera are continuous with one another, the limbus represents a transitional zone that is usually described histologically (not labeled in the figures). The free border of the iris forms the edge of the **pupil**. The **lens** is strongly curved in sea turtles (Fig. 214). It is suspended behind the pupil and iris by "ligaments" attached to striated muscles of the ciliary bodies. The chamber of the eye is filled with a clear viscous liquid, the **vitreous body**.

The eyes are photoreceptors that are capable of color and shape discrimination. The **retina** is the sensory layer of the eye; it detects color as well as brightness. The retina is composed of several cell layers and includes several types of rods and cones, each containing photopigments.

The **ears** of sea turtles are responsible for hearing and equilibrium. Each ear consists of an external **tympanum** covered by a tympanic scale that stretches across the **otic notch** (= auditory canal) formed by the quadratojugal and squamosal bones (Fig. 28). There is middle and inner ear but no outer ear. The **middle ear** is involved in sound transduction while the **inner ear** functions in sound reception and the detection of...
position and acceleration. The middle ear contains a single ear bone, the **stapes** (= columnella). The stapes extends from the tympanum via an **extrastapedial process** of cartilage (Fig. 217), through the **tympanic cavity** and **recessus cavi tympani**, to articulate via an expanded footplate (also cartilage) on the **vestibular window** of the **cochlea** (Fig. 218). A Eustachian tube extends to each middle ear from the mouth near the jaw joints (Fig. 165).

The inner ear of turtles is composed of the **cochlea** and 3 semicircular canals, all of which are encased in bone. The cochlea is involved in sound transduction and is innervated by the auditory nerve; it transmits sound information to the brain. The semicircular canals sense the head's position and movement by detecting changes in acceleration in the three planes. One canal resides in each plane (sagittal, coronal, and axial) in each ear.

**Fig. 217.** The tympanum of a ridley ear. The tympanic scale has been removed to expose the tympanum and the distal-most aspect of the extrastapedial process (at arrow).

**Fig. 218.** Ventral view of a ridley ear. The coronal section exposes the tympanic cavity (= the otic notch of a skull) and, more medially the recessus cavi tympani. The footplate of the stapes articulates with the vestibular window.