Biology and Conservation of Large Marine Vertebrates

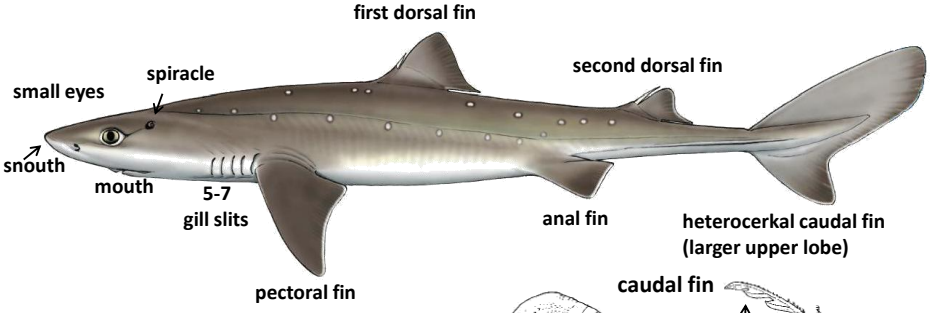
Lab: Elasmobranchs

Morphology, anathomy, sampling

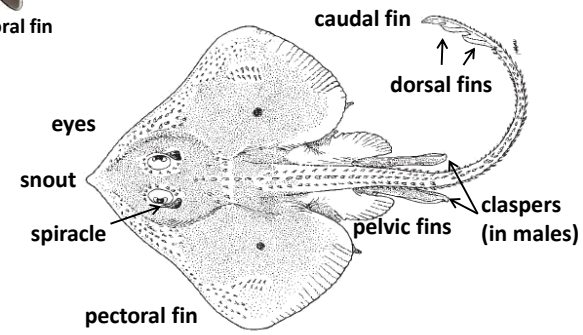
Assoc. Prof. Bojan Lazar, PhD

Department of Biodiversity
Faculty of Mathematics, Natural Sciences and Information Technologies
University of Primorska

Sharks /Selachii



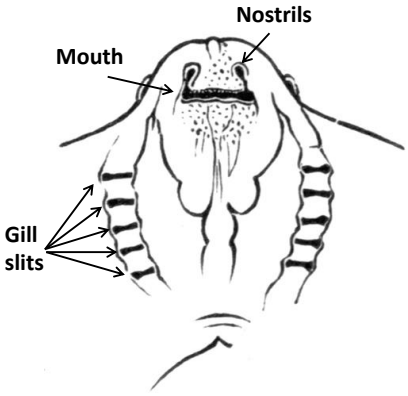
Rays / Batoidea



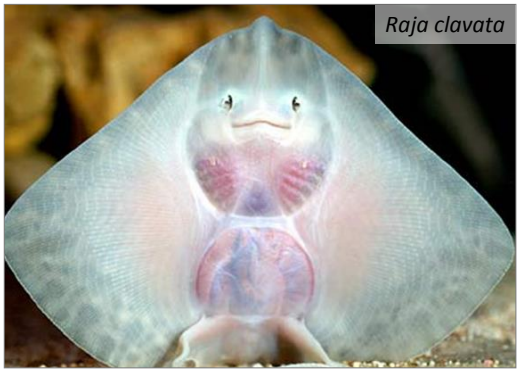
External morphology

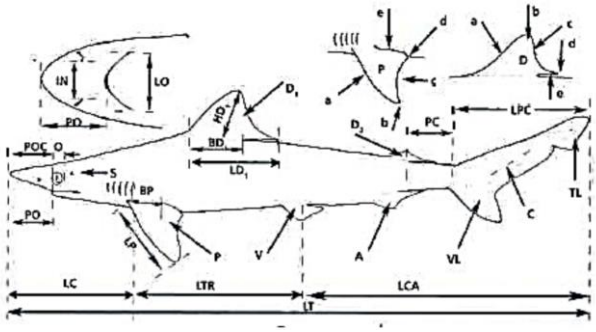
Skates and rays

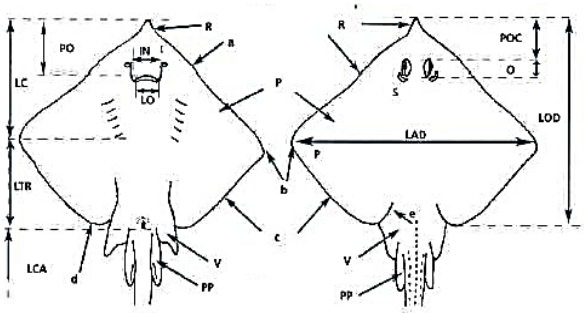
- external gill openings (5-6) – gill slits on the ventral side of the body

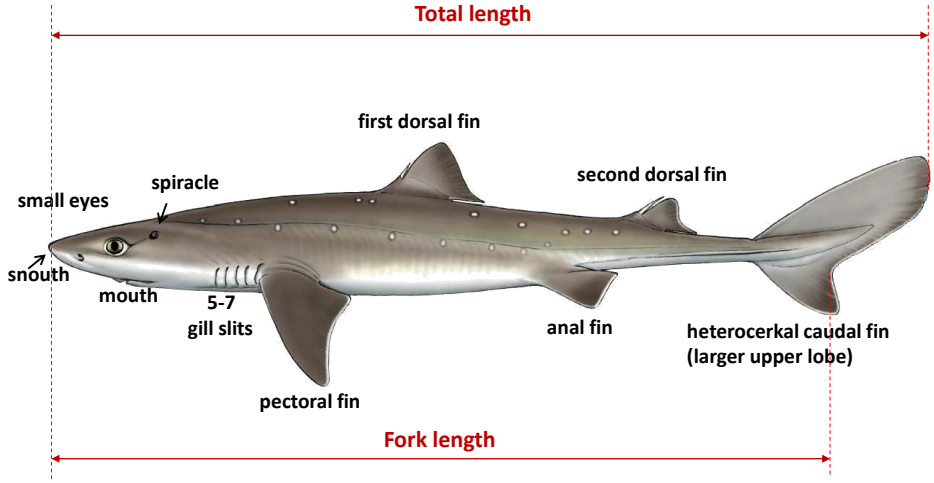


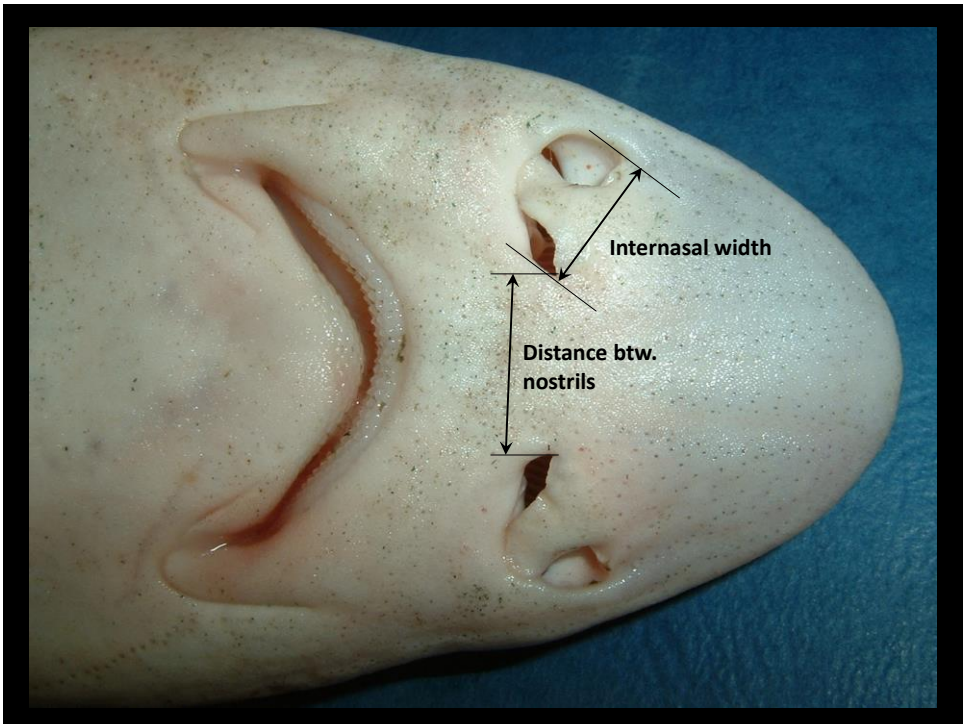
Ventral side







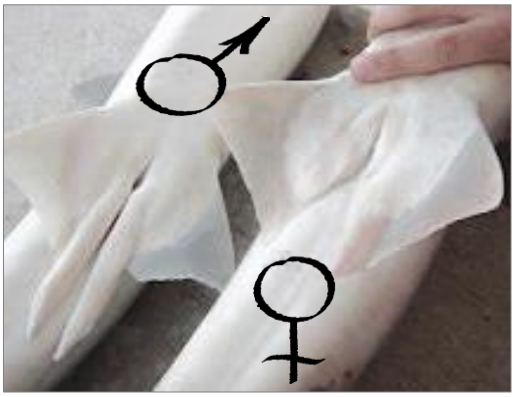

Total length
first dorsal fin
spiracle
second dorsal fin
small eyes
snouth
mouth
5-7
gill slits
anal fin
heterocerkal caudal fin
(larger upper lobe)
pectoral fin
Fork length

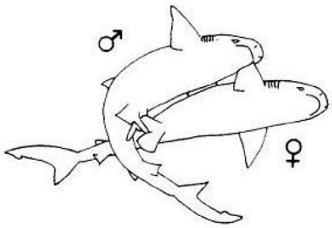

Internasal width
Distance btw.
nostrils

Characteristics of Elasmobranchs:

Claspers

- pterigopod
- copulatory organs for internal fertilization
- modified inner edges of the pelvic fin





Rays

Pristiformes, Torpediniformes, Myliobatidae, Dasyatidae

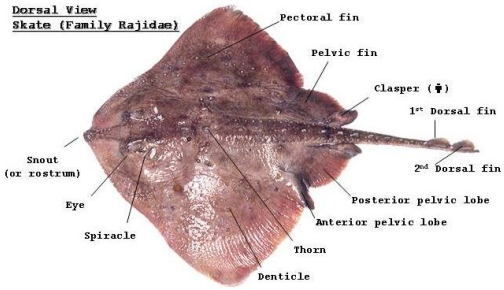
- No thorns along middline of the back
- Each pelvic fin has one lobe
- Slender, whipe-like tail with one or two spines, usually without a dorsal fin
- Caudal fin: reduced or absent
- In general, larger than skates
- viviparous

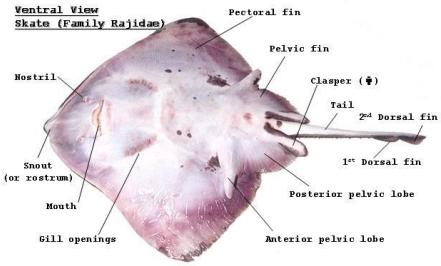
Myliobatis aquila - common eagle ray

Skates

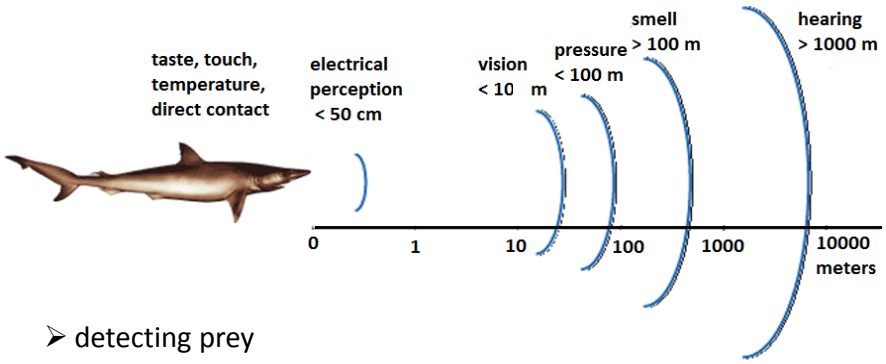
fam. Rajidae

- Not a taxonomic group (morphological group)
- Most have elongated thorns along the midline of the back
- Prominent rostrum
- Pelvic fin: two lobes
- Tail relatively stocky, without a spine, usually with two small dorsal fins near its tip, and small caudal fin
- oviparous





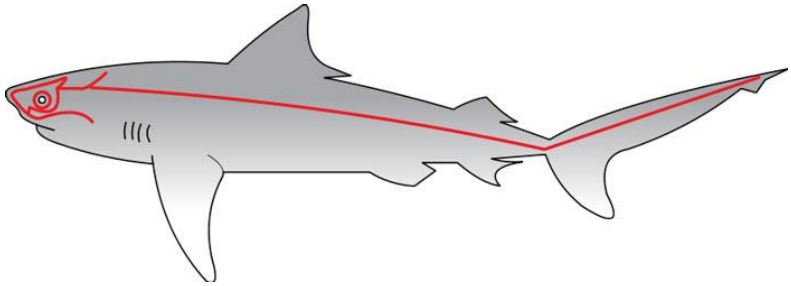
Sensory organs

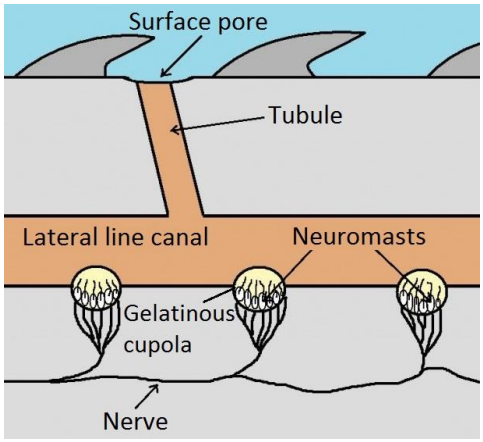


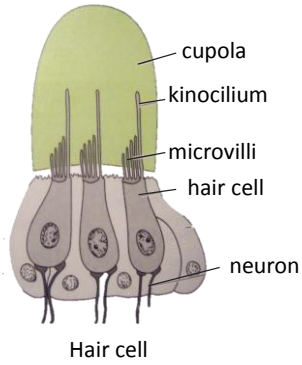
- detecting prey
- detecting partners for mating
- avoiding predators
- orienting in the sea

Lateral line

- lateral line - series of fluid filled canals along the shark's body
- detects movement through changes in the surrounding water pressure
- **neuromasts** – sensory cells encased in the gelatinous cupola, positioned within canals, connected with the surface of the skin by tubules







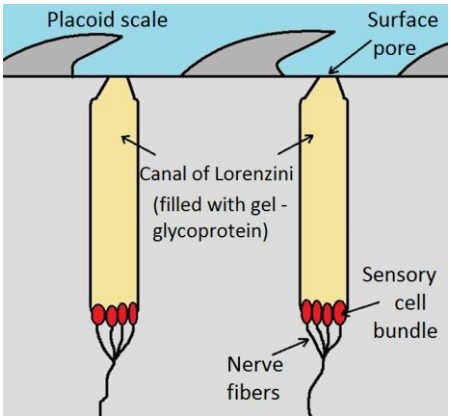
Hair cell

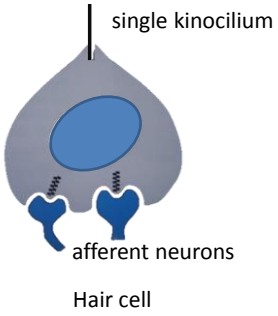
- neuromasts sense the water movement in the canal
- sensory cells have 1 kinocilium and several microvilli
- stimulation triggers a nerve impulse to the brain

Ampullae of Lorenzini

- electroreceptors
- described in the torpedo ray by Stefano Lorenzini in 1678
- located primarily on the snout, but also on the lower jaw and anterior to the first gill opening

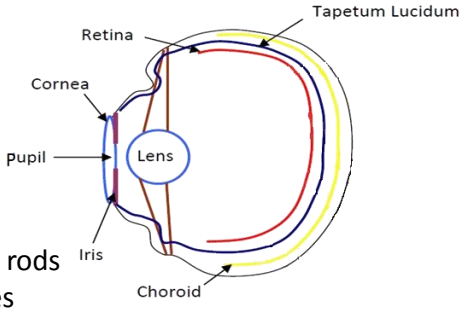
- all backboned animals produce weak electrical currents in their muscle fibers – polarization / depolarization
- produced by small muscular movements (e.g. respiration)





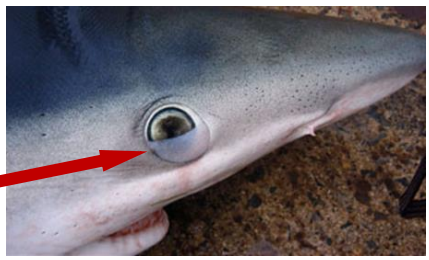
- electrical impulses travel through gel in canals
- gel has low resistance, easy conducts small electrical impulses
- each ampulla has a bundle of sensory hair cells which resond to a reversal of electrical polarity, and are enervated by nerve fibers
- sensory cells have 1 kinocilium and no microvilli

Sight



- lens are large and spherical
- retina has a greater proportion of rods (light intensity sensors) than cones (color sensors) - sensitive to differences in light intensity
- sharks focus by changing the position of the lens by moving it toward or away from the retina
- **a tapetum lucidum** - a reflective layer in the back of the eye; improves vision in low light conditions
  - phenomena known as “eye shine”

Eyes

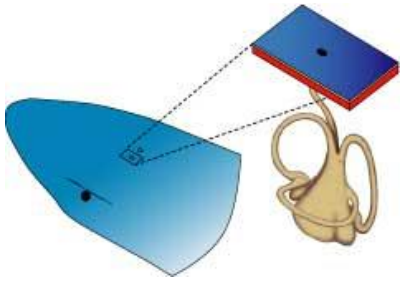


- **nictitating membrane** - protects the exposed portion of the eye during feeding or object contact

- sharks have poor eyesight?
  - sharks have a good visual acuity, with range of sight and color recognition comparable to humans
  - juvenile lemon shark has a lens with 7 times the optical power of a human lens
  - laterally placed eyes allow around 360° visual field

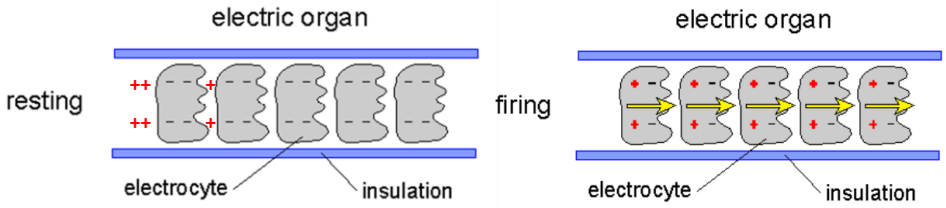
Hearing

- sharks use sound to locate food
- sound moves through water about four times faster than through air, and lower frequencies can travel longer distances than high ones
- sharks hearing functions in the low frequency range 25 - 100 Hz
- shark's two hearing organs are embedded in the skull cartilage
- hearing organs are connected externally only by an endolymphatic duct
- endolymphatic duct ends in a tiny pore on top of the head



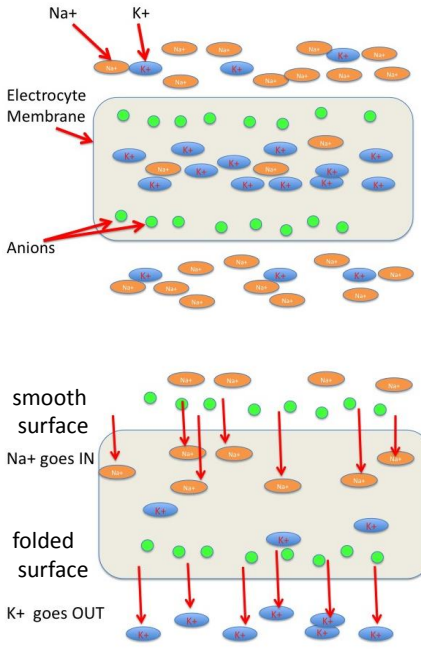
Electrogenic fishes

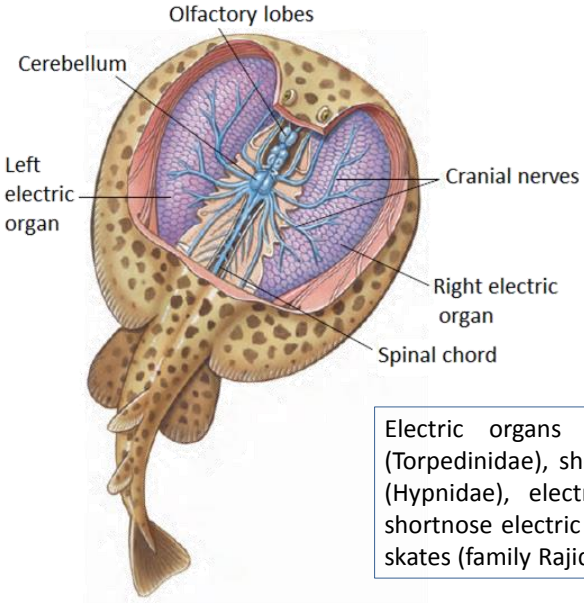
- **electric organs** - modified from striated muscle fibers, consisting of stacks of disclike flattened cells innervated on one side (smooth surface) – **electrocyte**
- act as serially conected bateries
- evolved from smaller organs for communication and navigation
- role: stunning prey and discouraging intruders or predators



electrocytes contain a high concentration of Potassium (K) ions and a comparable amount of negatively charged ions

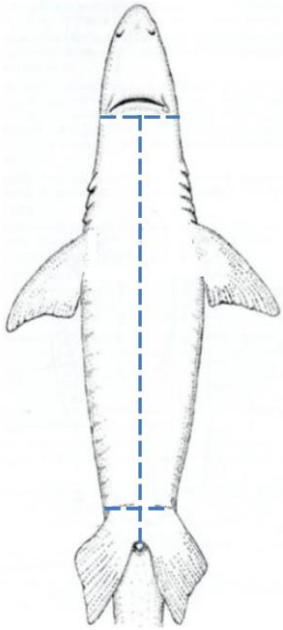
- cell membrane is permeable to potassium ions
- <u>activated</u>: Sodium ions rapidly enter the cell via ion channels
- Potassium ions exit cells
  - influx of positive charge alters the equilibrium potential of the cell

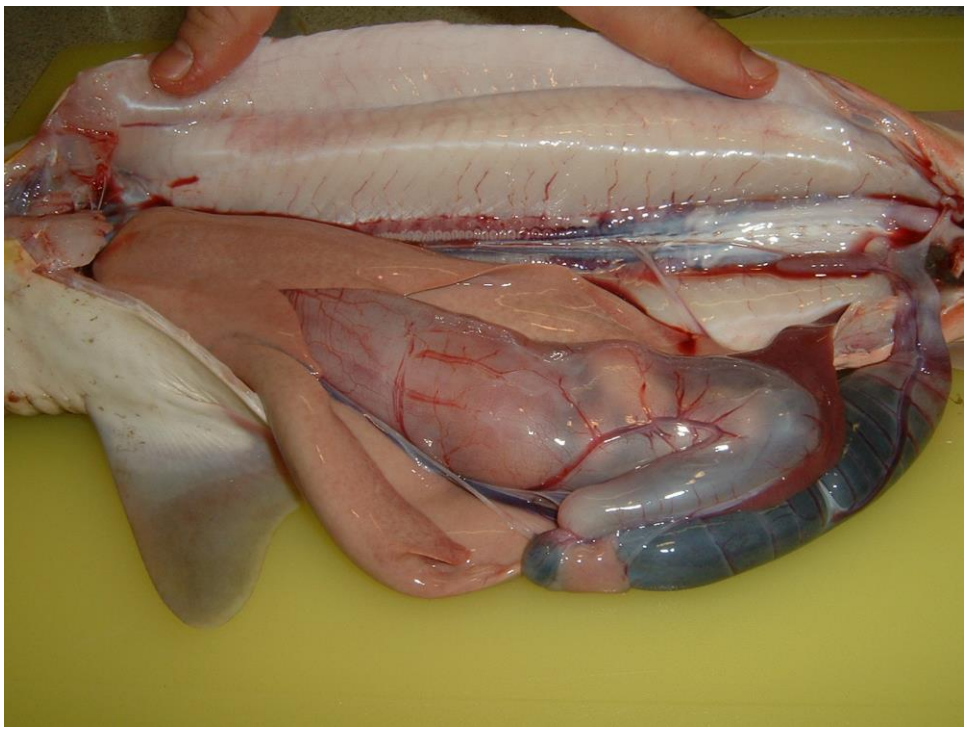


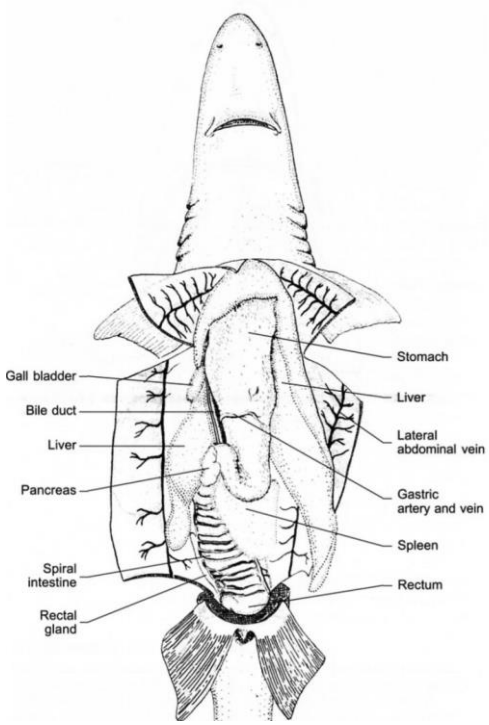


Electric organs have: Torpedo rays (Torpedinidae), short-tailed electric rays (Hypnidae), electric rays (Narcinidae), shortnose electric rays (Narkidae), some skates (family Rajidae)

- electric rays have large electric organs on each side of the head
- electric discarge up to 220 volts



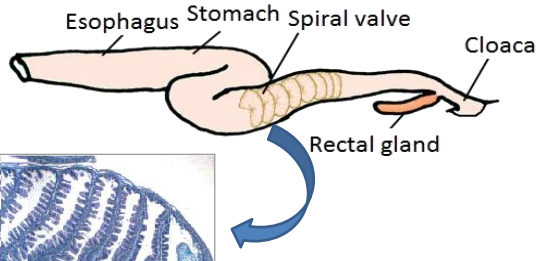


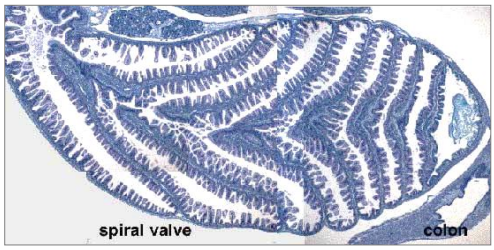


Digestion

Spiral valve – the lower portion of the digestive tract

- internally twisted or coiled to increase the surface area
- slows the passage of food, increased surface area for digestion and nutrient absorption





Cloaca - a common opening for the urinary, digestive, and reproductive systems

Osmoregulation

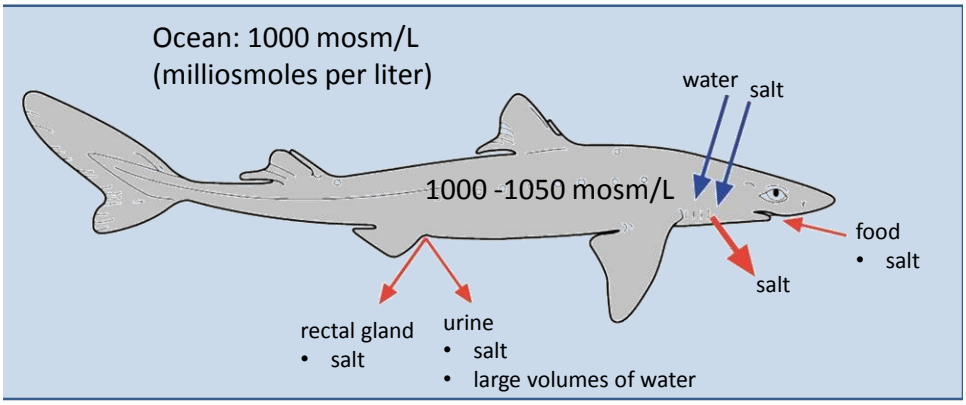
- **Osmoconformers** - they maintain osmotic balance with the seawater or slightly higher than the sea (hypertonic)
- collect urea in the blood and body fluids for osmotic balance
- Chondrichthyans do not drink seawater

- organs: kidneys - produce and transport urine
  - extract urea from urine and return the urea to the blood
  - gills - active extrusion of salt
  - rectal gland - removes excess sodium chloride (salt) from the blood

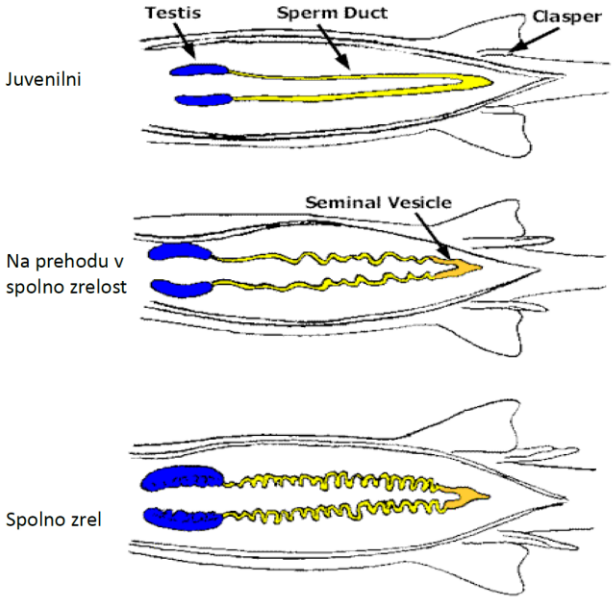
Osmoregulation

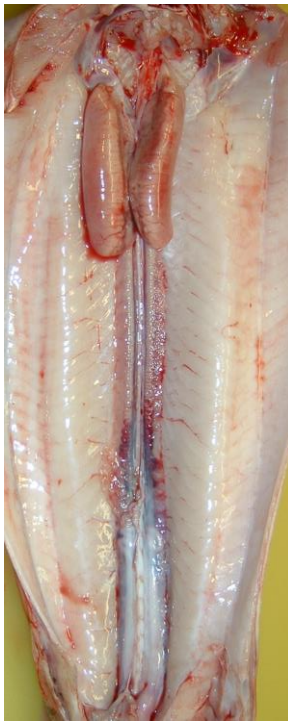
Passive movements →

Active pathways →



Evans (2003)

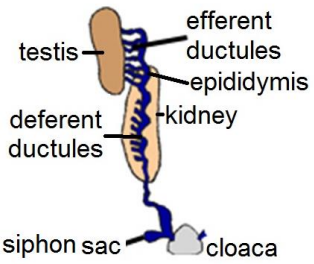


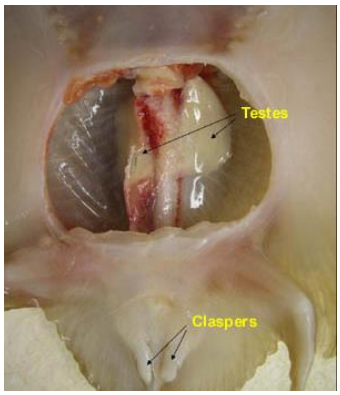


Reproduction

Males

- both testes are active
- testes are often enveloped in an epigonal organ, which plays role in blood-cell formation
- ductus deferens is a sperm-storage organ
- siphon sacs - hold seawater used to wash sperm from the clasper into the female

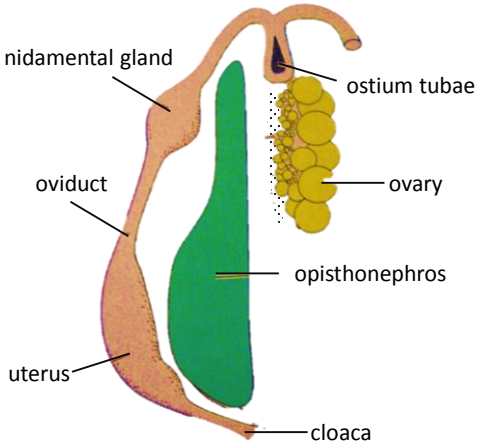


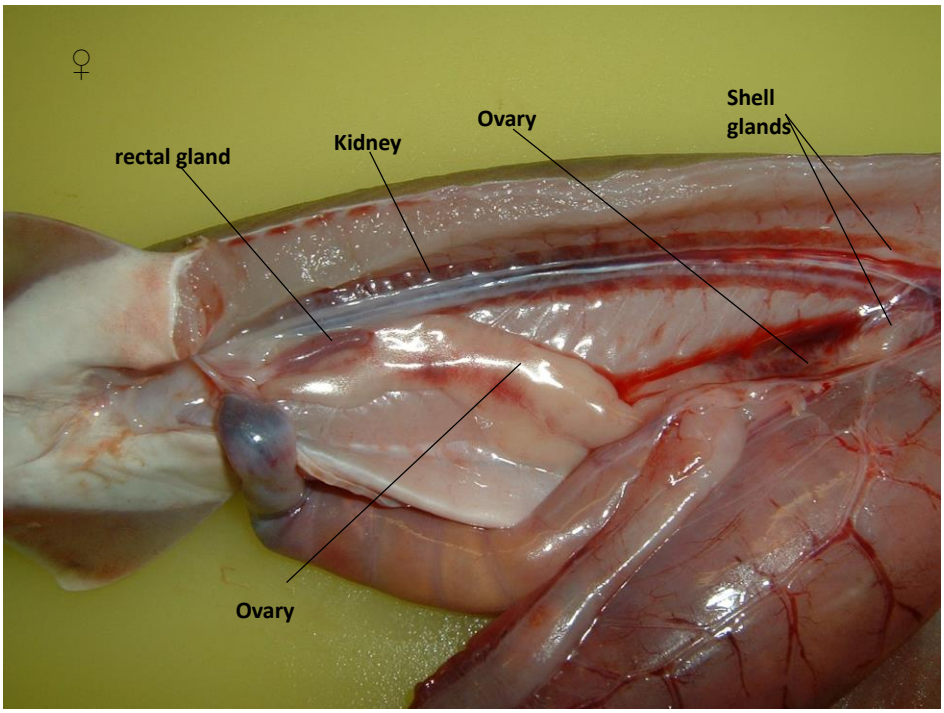


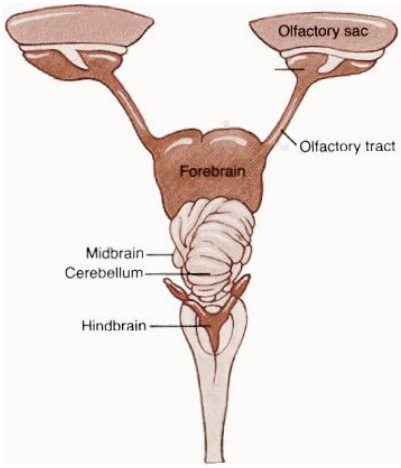
Reproduction
Females

- internal fertilization
- variety of reproductive modes
- eggs are transmitted through oviductal (nidamental or shell) glands - specialised anterior regions of the oviducts
- nidamental gland
  - sperm storage
  - mucus, albumen and egg shell production

Both ovaries are functional in ancient shark groups, while advanced forms have only one ovary (e.g. *Scyliorhinus, Carcharhinus, Mustelus, Sphyrus*)

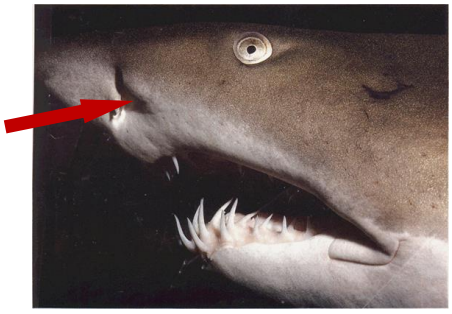






Smell – primary sense

- paired nostrils located on the underside of snouts
- water continually flows through the nostrils



≈70 % of the shark's brain is used for olfactory sense