



REPTILIA

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Characteristics of Class Reptilia

- **Class reptilian (L. Reptilia= creeping) includes animals which are cold blooded.**

Skin of Reptiles

Reptiles skin is covered with scutes or scales.

- **few cutaneous glands - keratin,**
 - prevents water loss through the skin
- **scales - made of keratin**
 - formed from the **epidermis**
- **Scutes - made of keratin**
 - formed from the deeper **Dermis**

Crocodiles and alligators have large scales (scutes), which are shed individually .



Scutes on a live Alligator



**Alligator
Scute Fossils**

A turtle's skin is shed like a lizard's. The hard shells of most turtles are not shed. Instead new layers are added to the underside of their shells. The age of the turtle can be determined by the number of rings on its shell's scutes.



Turtle Scutes



- **tetra pods** with two sets of paired limbs.
 - Mostly have **five clawed toes** on each limb.
- **spinal columns and a strong skeletal system** with a **rib cage**.
- **well-developed brain and a central nervous system**.
- **Twelve pairs of cranial nerve** is present.

In higher vertebrates (**reptiles**, birds, mammals) there are 12 pairs of **cranial nerves**: olfactory (I), optic (II), oculomotor (III), trochlear (IV), trigeminal (V), abducent (VI), facial (VII), vestibulocochlear (VIII), glossopharyngeal (IX), vagus (X), accessory (XI), and hypoglossal (XII).

- **three-chambered hearts, except crocodiles**
- **digestive system** which has a muscular opening (**cloaca**) is present at the base of the tail.
- In case of reptiles inhabiting arid regions, water is further absorbed into the body and only the remaining waste is excreted.

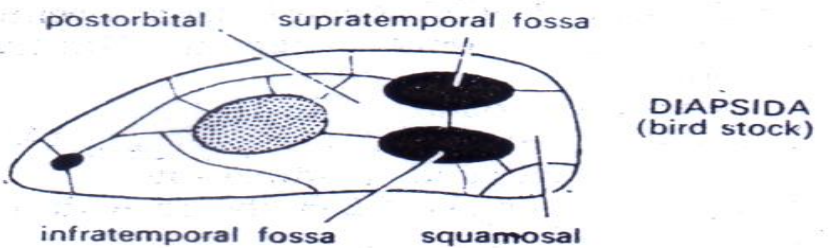
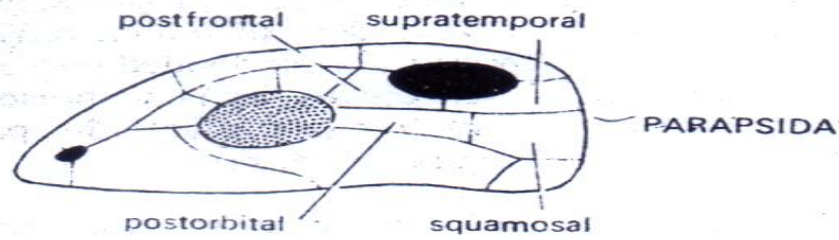
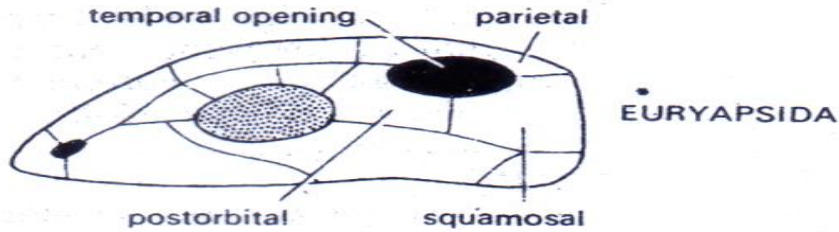
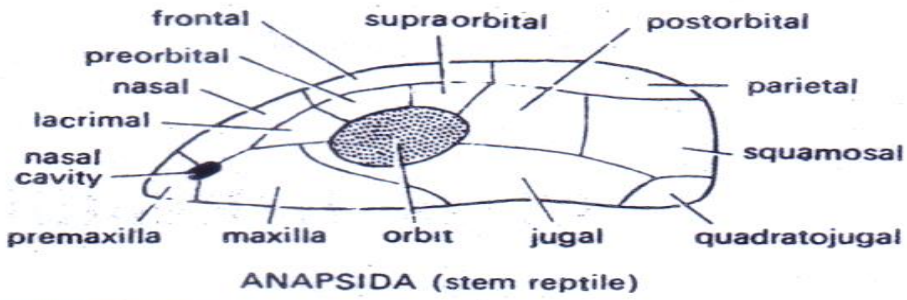
- the first animals with **amniotic eggs**
 - laid on land - **can survive without water**
 - have protective shells and membranes that allow oxygen and other gases to enter.
- **reptiles do not pass through an embryonic stage with gills - animals breathe with well-developed lungs, right from birth.**
- **There is no metamorphosis – offspring resemble the adults at the time of birth itself.**

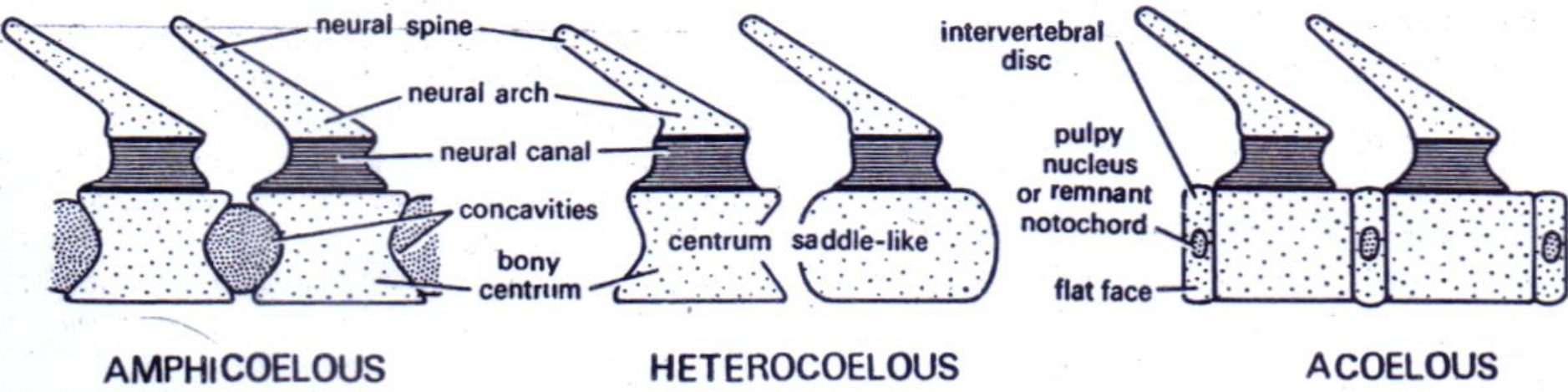
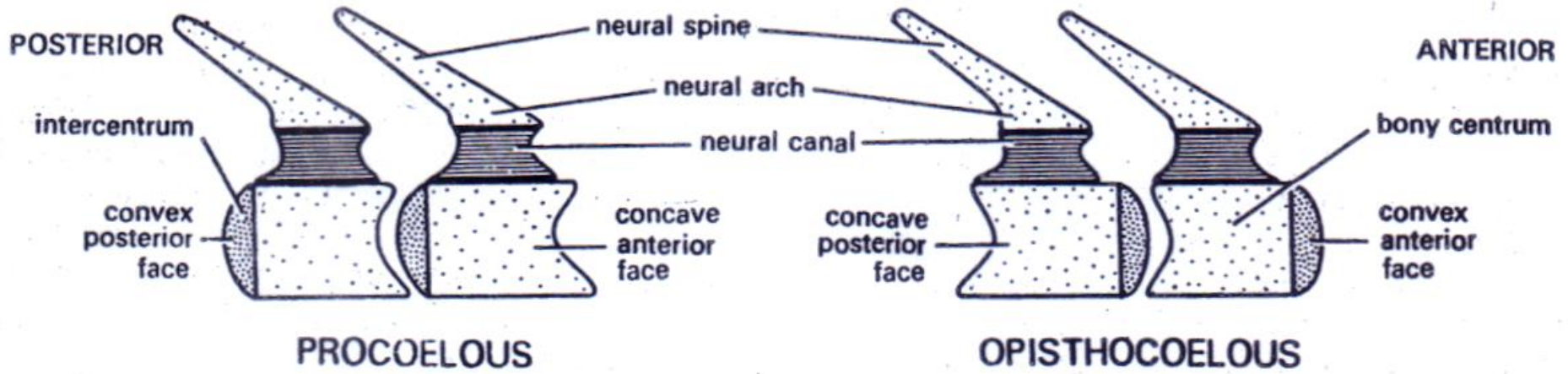
- Lateral sense organs are absent.

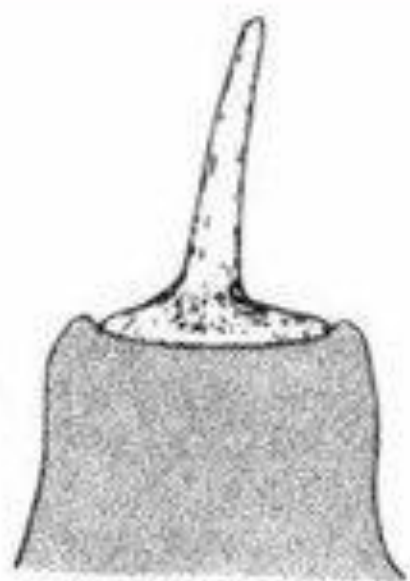
The **lateral sense organs** found in aquatic vertebrates, used to detect movement and vibration in the surrounding water.

- **Internal fertilization**

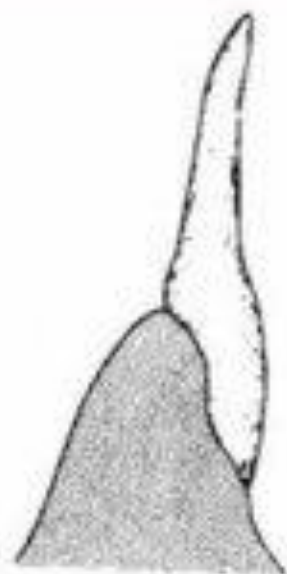
Reptile Classification



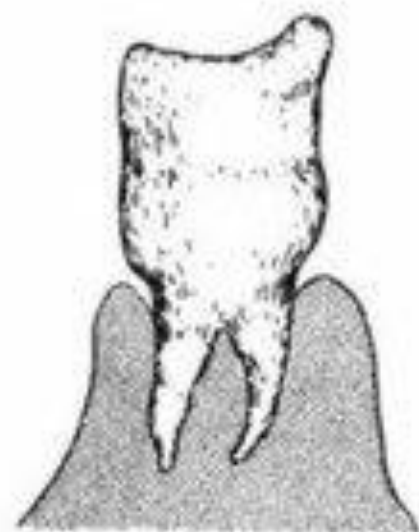




Acrodont



Pleurodont



Thecodont

Subclass I – ANAPSIDA

(i) Roof of skull is complete and no temporal openings.

This sub class includes one living order.

Order – 1 – Chelonia or Testudinata

(i) Body is short, broad and oval.

(ii) Limbs clawed and webbed and paddle like.

(iii) Body encased in a firm shell of dorsal carapace and ventral plastron, made of dermal bony plates.

(iv) Thoracic vertebrae and ribs usually fused to carapace.

(v) No sternum is found.

(vi) Teeth absent Jaws with horny sheath.

(vii) Cloaca with a longitudinal slit.

(viii) Heart incompletely 4- chambered.

(ix) Copulatory organ simple and single.

(x) Quadrate is immovable. Nasal opening single and media.

(xi) Oviparous.

(xii) There are about 400 species.

Example – Chelone, Testudo, Trionyx.

Subclass – II – EURYAPSIDA (Extinct)

- (i) Skull with a single dorsolateral temporal opening on either side.
- (ii) These openings are bounded below by postorbital and squamosal bones.
- (iii) They lived during Triassic period.

Subclass III PARAPSIDA (Extinct)

- (i) Skull with a single dorsolateral temporal opening on either side.
- (ii) These openings are bounded below by the supratemporal and postfrontal bones.
- (iii) They lived during Mesozoic to Cretaceous period.

Subclass – IV – SYNAPSIDA (Extinct)

- (i) Skull with a single lateral temporal opening on either side.
- (ii) These openings are bounded above by the postorbital and squamosal bones.
- (iii) They lived during Carboniferous period.

Subclass – V – DIAPSIDA

- (i) Skull with two temporal openings on either side separated by the bar of postorbital and squamosal bones.

This sub class includes 3 orders.

Order – 2 Rhynchocephalia

- (i) Body small, elongated, lizard –like
- (ii) Limbs pentadactyle, clawed and burrowing.
- (iii) Skin covered by granular scales and a middorsal row of spines.
- (iv) Vertebrae amphicoelous or biconcave.
- (v) Numerous abdominal ribs present.
- (vi) Teeth acrodont.
- (vii) Cloacal aperture transverse
- (viii) No copulatory organs in male.

Example – Represented by a single living species, **Sphenodon punctatum** or **tuatara**

Order – 3 Squamata

- (i) Body small to medium, elongated and advanced.
- (ii) Limbs, clawed, absent in **snakes** and few **lizards**.
- (iii) Body covered by horny epidermal scales, shields and spines.
- (iv) Vertebrae procoelous.
- (v) Ribs single headed.
- (vi) Teeth acrodent or pleurodent.
- (vii) Cloacal aperture is transverse
- (viii) Male with eversible double copulatory organs (hemipenes)

This order includes two **suborders**.

Sub order – 1 **Lacertilia**

Sub order – 2 **Ophidia**

Suborder 1 – Lacertilia

- (i) Commonly known as lizards.
- (ii) Limbs and girdles usually welldeveloped.
- (iii) Eyelids movable. Nictitating membranes present.
- (iv) Ear openings and tympanum present.
- (v) Maxillae, palatines and pterygoids fixed.
- (vi) Mouth nonexpansible.
- (vii) Sternum, episternum and urinary bladder usually present.
- (viii) Tongue rarely notched or extensile.

Example – hemidactylus, Calotes, Uromastix Varanus, Chamaeleon, Draco.

Suborder 2- Ophidia

- (i) Commonly known as snakes.
 - (ii) Limbs and girdles absent, vestigial hindlimbs and pelvic girdle in boa, python etc.
 - (iii) Eyelids fixed. Nictitating membranes absent.
 - (iv) Auditory openings and tympanum lost.
 - (v) Maxillae, palatines and pterygoids movable helping in biting mechanism.
 - (vi) Mouth can be widely separated.
 - (vii) Sternum, episternum and urinary bladder usually absent.
 - (viii) Tongue slender, bifid and extensible.
- Ex Python, Boa, Naja, Bungarus, Vipera etc.

Order – 4 – Crocodilia

- (i) Body largesized, carnivorous and aquatic reptiles.
 - (ii) Limbs short but powerful, clawed and webbed.
 - (iii) Tail long, strong and laterally compressed.
 - (iv) Body surface covered by horny epidermal scales, bony plates and scutes.
 - (v) Teeth thecodont, numerous.
 - (vi) Abdominal ribs present.
 - (vii) Cloacal aperture is a longitudinal slit.
 - (viii) Heart completely 4 chambered.
 - (ix) Male with a median, erectile, grooved penis.
- Ex – Crocodylus, Alligators etc.

Key to identify Poisonous from non-poisonous snakes of India

Structures	Characters	Nature	Snakes
Tail	Laterally compressed, oar-like	Poisonous	Sea snakes- <i>Hydrophis</i> , <i>Enhydrina</i>
	Cylindrical, tapering	Poisonous/ non poisonous Examine further	Land snakes

Structures	Characters	Nature	Snakes
Belly scales or ventrals	Belly scales small, continuous with dorsals	Non poisonous	
	Ventrals not fully broad to cover belly	Non poisonous	Pythons
	Ventrals broad, fully covering belly	Examine further	

Structures	Characters	Nature	Snakes
Head scales, loreal pit, sub-caudals	a) Head scales small. Head triangular. No loreal pit.	Poisonous	Pitless vipers
	i) Sub-caudals double	Poisonous	<i>Vipera russelli</i>
	ii) Sub-caudals single	Poisonous	<i>Echis carinata</i>
	b) Head scales small. A loreal pit present between nostril and eye.	Poisonous	Pit vipers Lachesis, Ancistrodon
	c) Head with large shields. No loreal pit.	Examine further	

Structures	Characters	Nature	Snakes
Vertebrals, 4th infralabial, 3rd supralabial	a) Vertebrals enlarged, hexagonal, 4 th infralabial largest	Poisonous	Krait, Bungarus
	b) Vertebrals not enlarged, 3 rd supralabial touches eye and nostril	Poisonous	
	i) Neck with a hood and spectacle mark	Poisonous	Cobra, Naja
	ii) Hood absent. Coral spots on belly	Poisonous	Coral snakes, Callophis
	c) No such marks	Non poisonous	

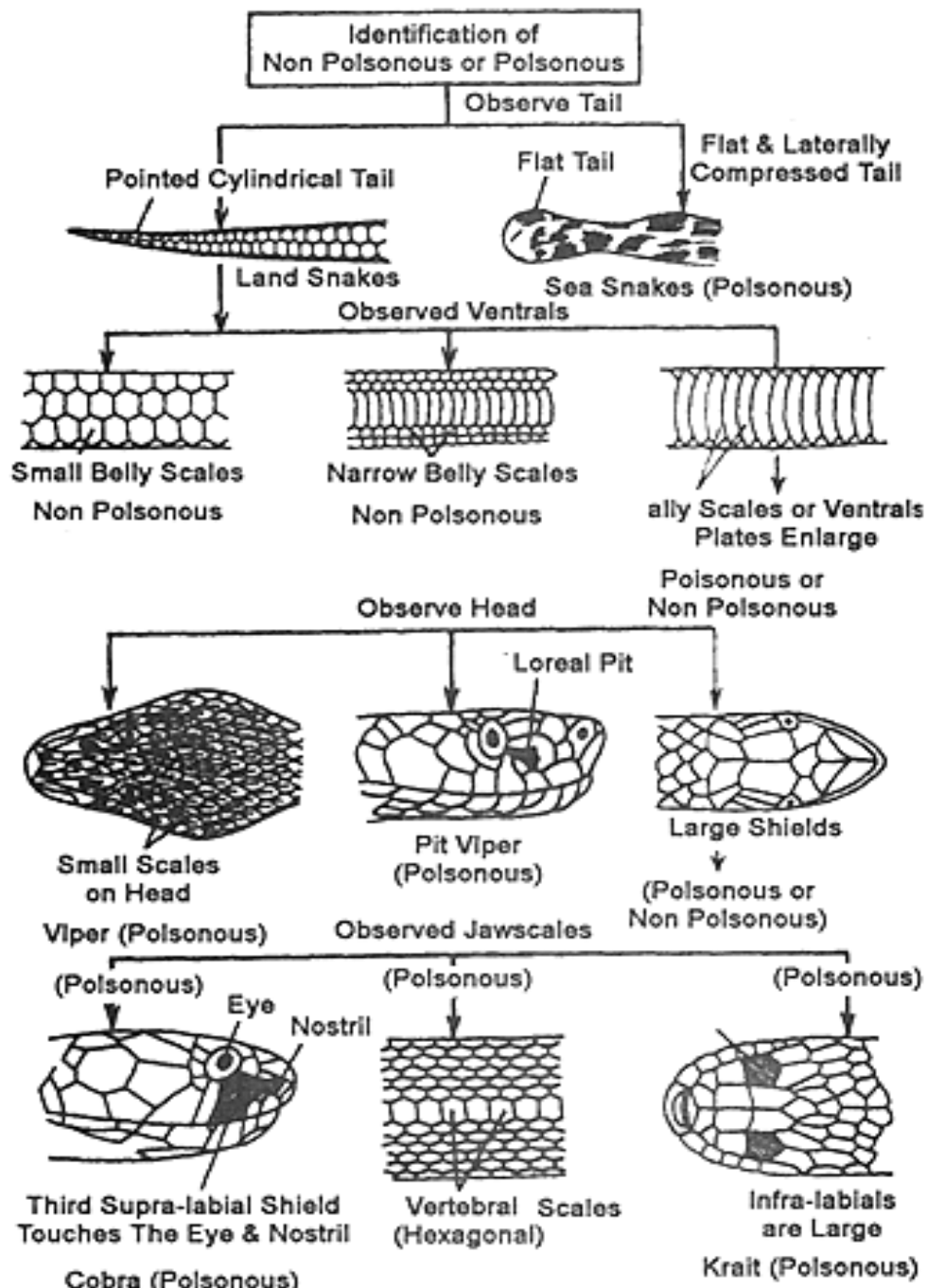


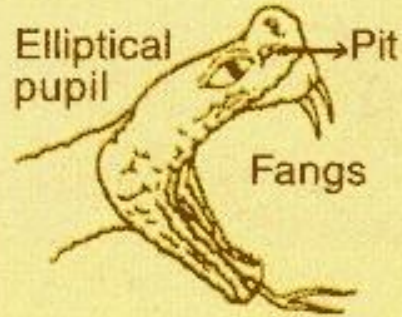
Table of Identification of Poisonous and Non Poisonous Snakes



Poisonous Snake



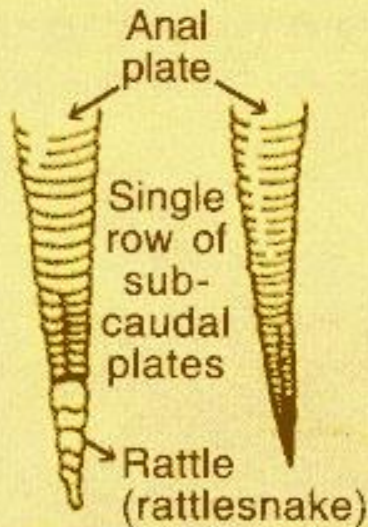
Triangle-shaped head



Elliptical pupil

Pit

Fangs



Anal plate

Single row of sub-caudal plates

Rattle (rattlesnake)

Non-Poisonous Snake

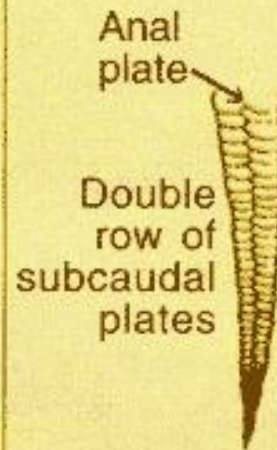


Rounded head



Round pupil

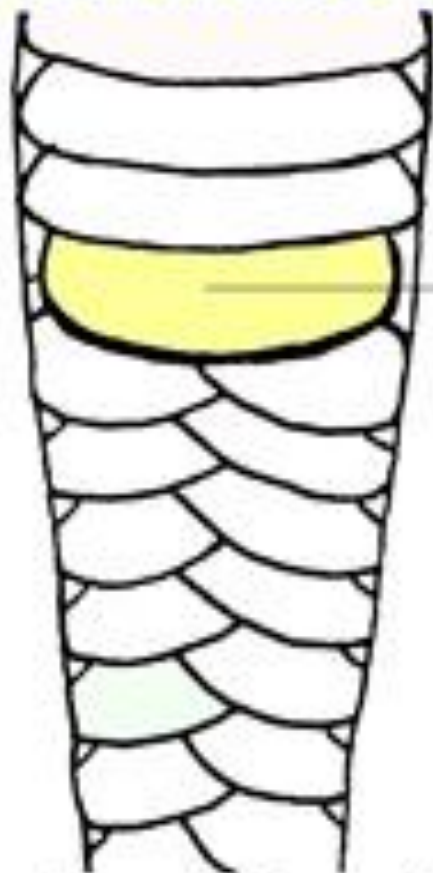
No fangs



Anal plate

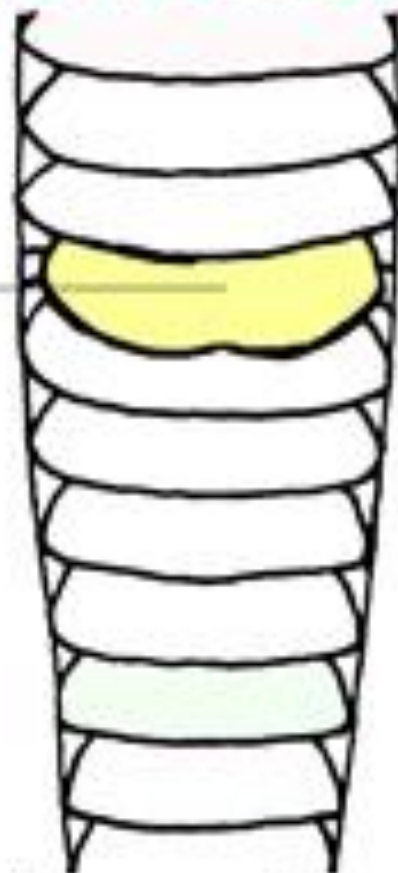
Double row of subcaudal plates

Harmless



Dual row of scales
after anal plate

Venomous



Single row of scales
after anal plate

Snakes of India

- World land and marine snakes - 2600 species
 - Poisonous - only 300 species.
 - species number diminishing through the polar regions.
- In India, reported snakes species - only 330
 - Poisonous - only 69 species
- two categories of Poisonous snakes based on fangs
 - Proteroglypha- permanently erected (fixed) fangs
 - Solenoglypha- movable (folded) fangs - can rise to an erect position

Non-poisonous snakes of India



Common Wolf Snake

(*Lycodon aulicus*
Linnaeus, 1758)



Bloody-Bellied Shieldtail

(*Rhinophis sanguineus*
Beddome, 1863)



Beddome's Worm Snake

(*Gerrhopilus beddomii*)



Light-Barred Kukri Snake

(*Oligodon albocinctus*)



Diard's Worm Snake

(*Argyrophis diardii*)



Twin-Spotted Wolf Snake

(*Lycodon jara*)



Russell's Kukri
(*Oligodon taeniolatus*)



Copper-Headed
Trinket
(*Coelognathus radiatus*)



Rat Snake
(*Ptyas mucosa* (Linnaeus, 1758))



Common Sand Boa
(*Eryx conicus*)



Red Sand Boa
(*Eryx johnii*)



Indian Rock Python
(*Python molurus*)

Poisonous snakes of India



Spectacled Cobra
(*Naja naja*)



Andaman Cobra
(*Naja sagittifera*)



Monocled Cobra
(*Naja kaouthia*)



Common Krait
(*Bungarus caeruleus*)



Saw Scaled Viper
(*Echis carinatus*)



Russell's Viper
(*Daboia russelii*)



King Cobra
(*Ophiophagus hannah*)



Hump-Nosed Pit
Viper
(*Hypnale hypnale*)



Wall's Krait
(*Bungarus walli*)



Banded Krait
(*Bungarus fasciatus*)



Black Krait
(*Bungarus niger*)



North-Eastern Hill
Krait
(*Bungarus bungaroides*)

POISON APPARATUS

1. Poison glands

2. Poison ducts

3. Poison teeth or Fangs

a) Proteroglyphous type:

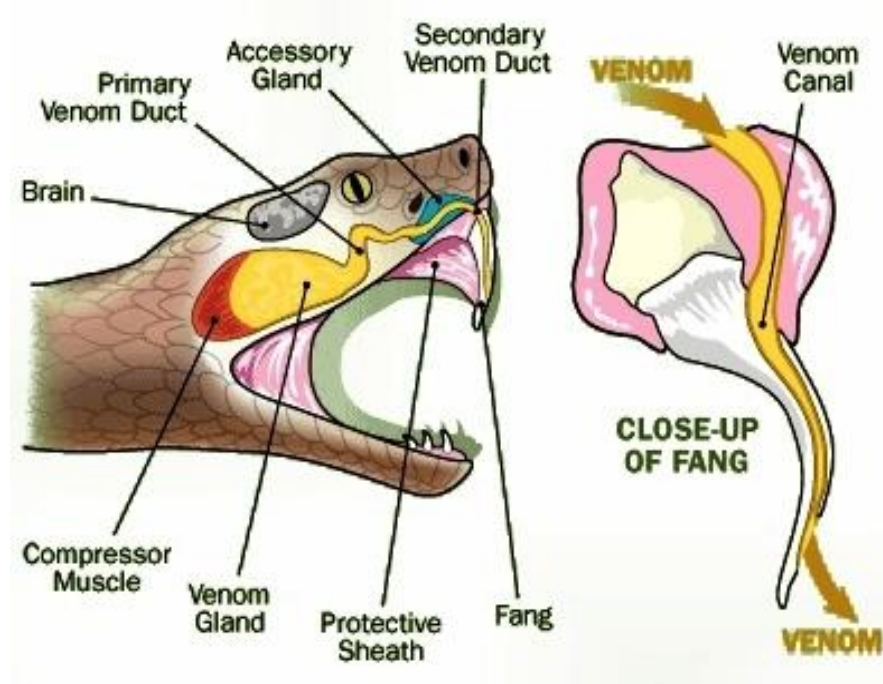
The fang has a groove all along its anterior face.
Examples: Cobra, Krait, Sea snakes and Coral snakes.

b) Stenoglyphous type:

Poison canal runs through the fang and opens at the tip.
Examples: Vipers and Rattle snakes.

3) Opisthoglyphous type:

The fang has a groove along its posterior face.
Examples: Some colubrid snake (African tree snakes).



Biting mechanism/Opening and Closing of Mouth/Process of biting

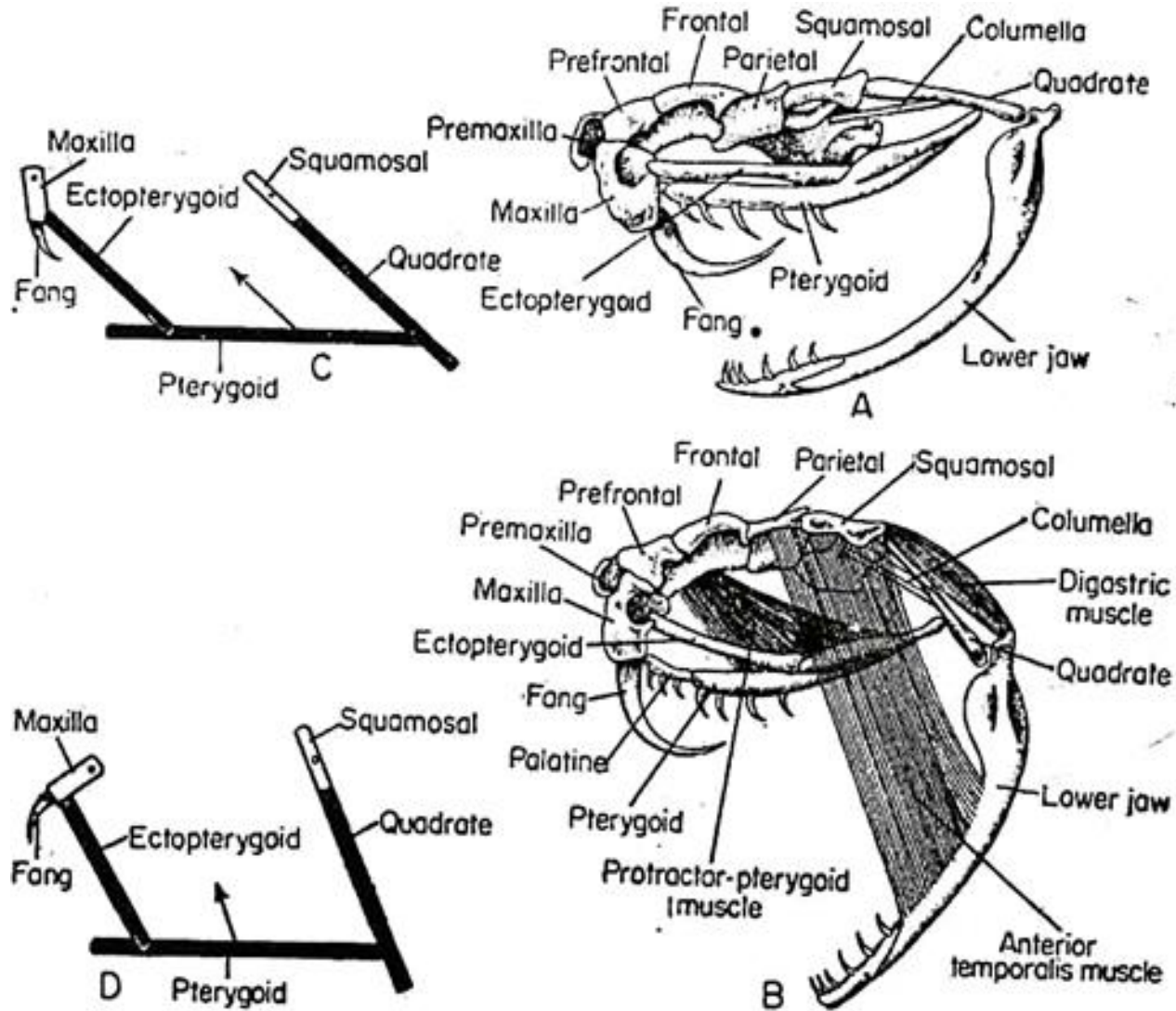
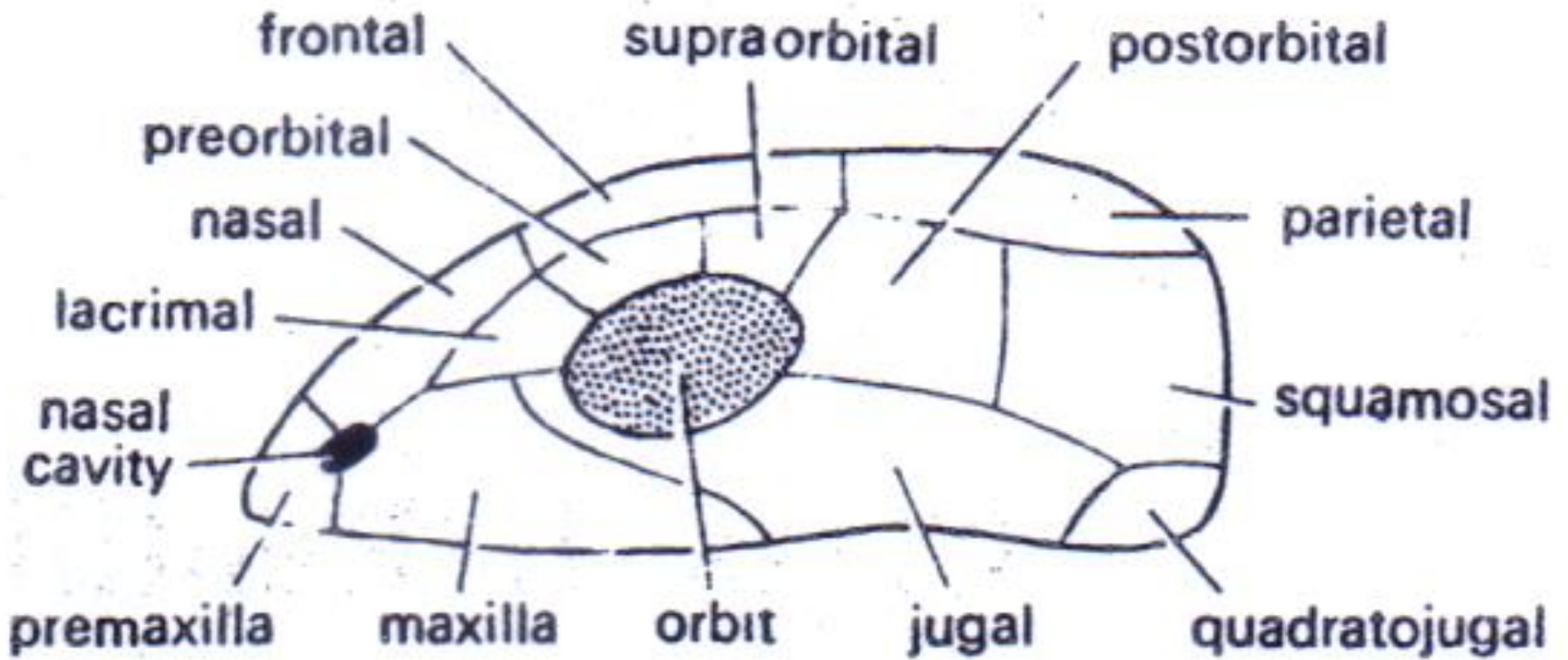


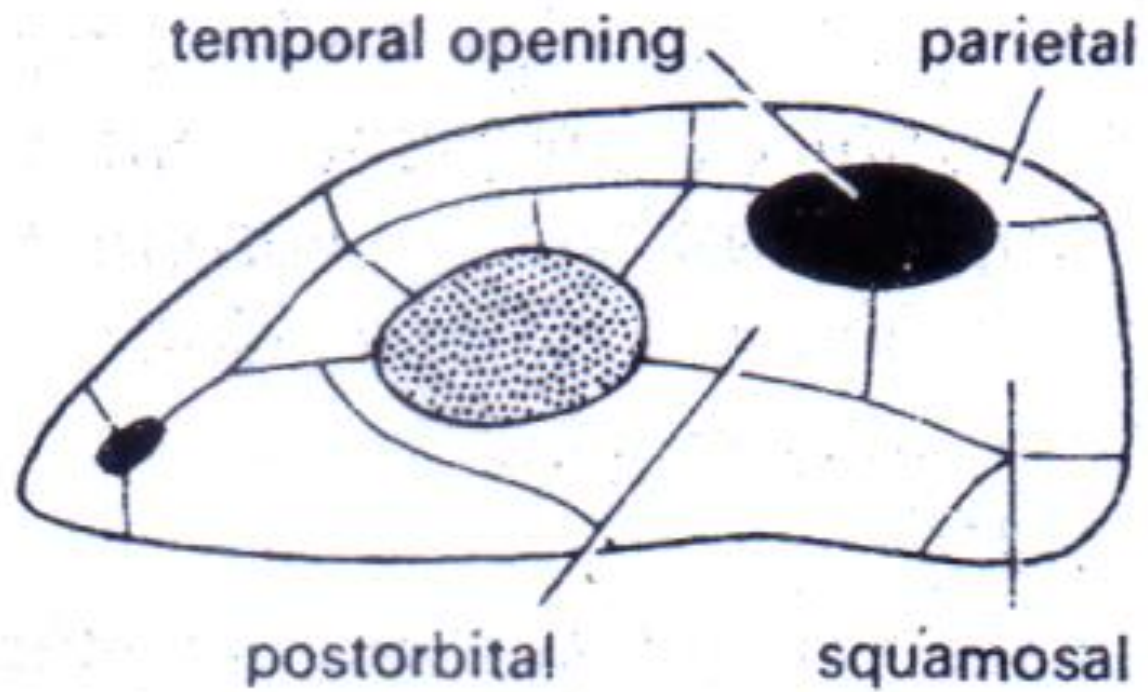
Fig. 142G. Mechanism of Bite of a poisonous snake.

Temporal fossae and arcades in reptiles



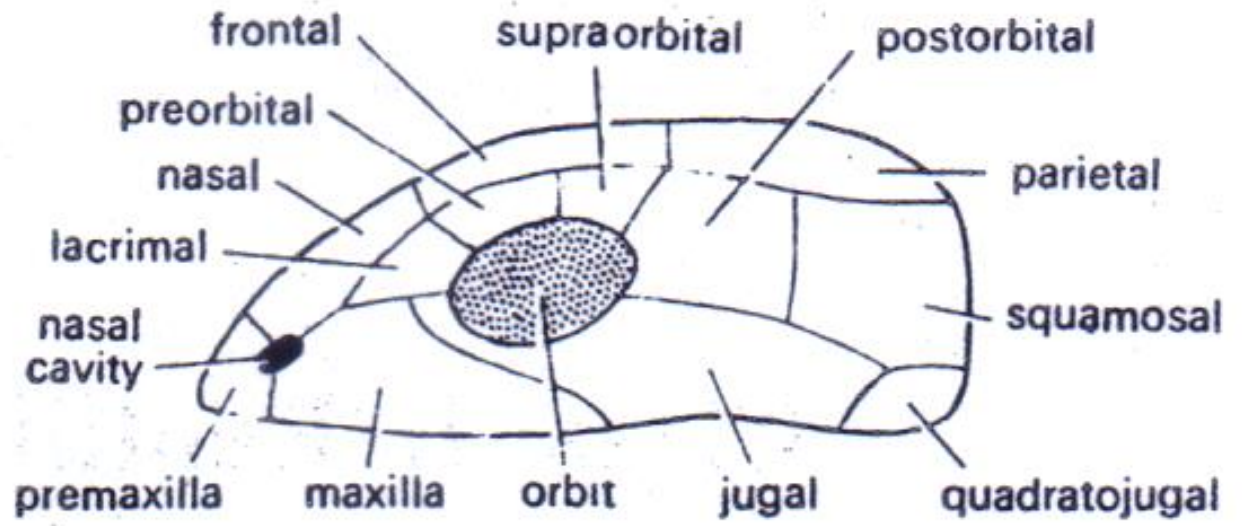
ANAPSIDA (stem reptile)

Stegocephalia and the primitive reptiles Cotylosauria

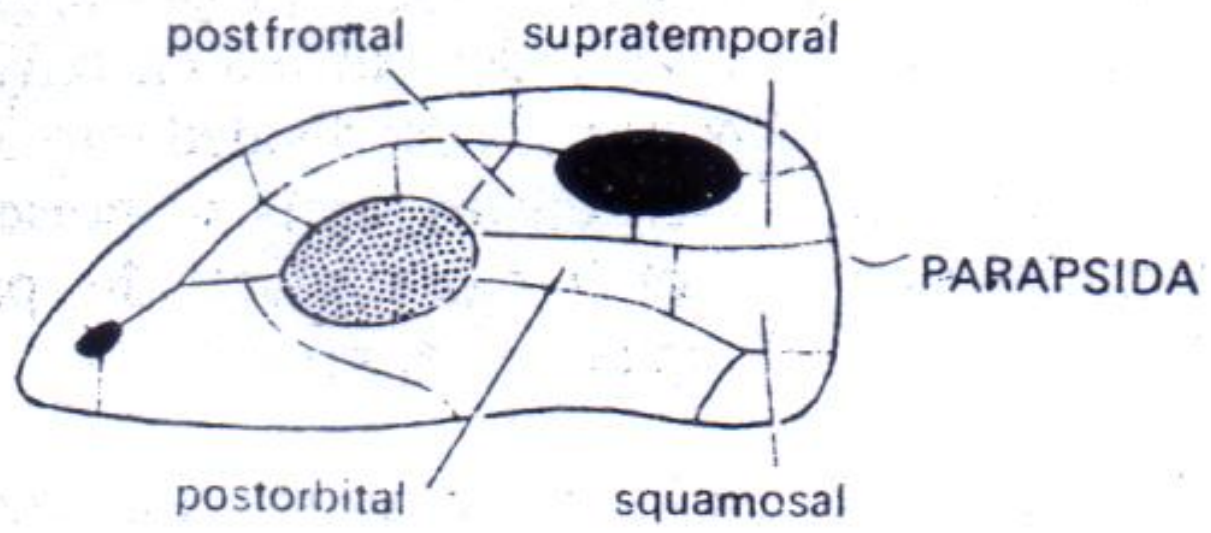


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EURYAPSIDA

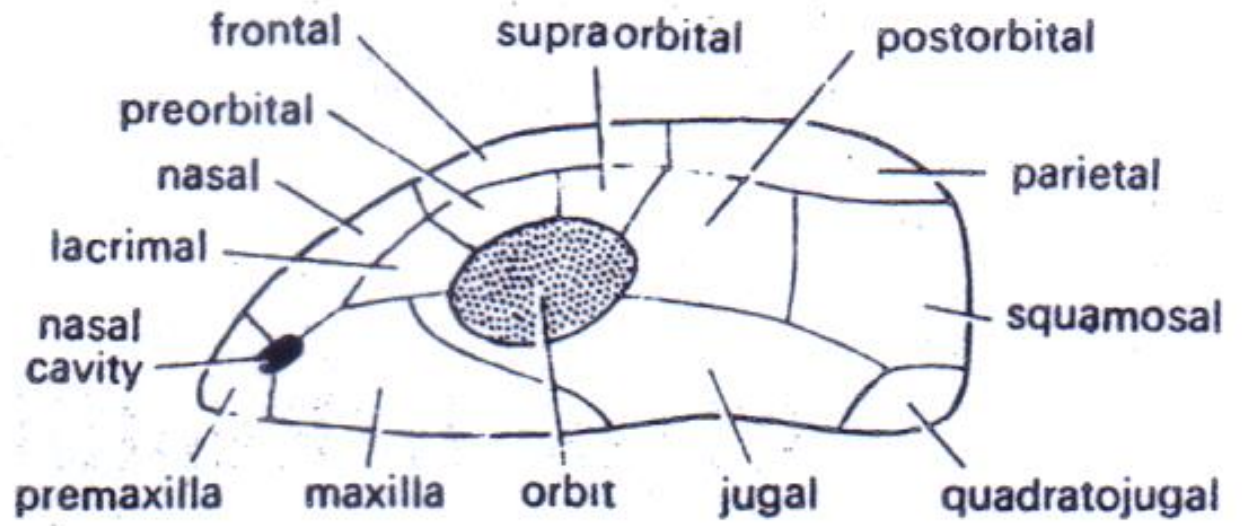
marine reptiles - ichthyosaurs



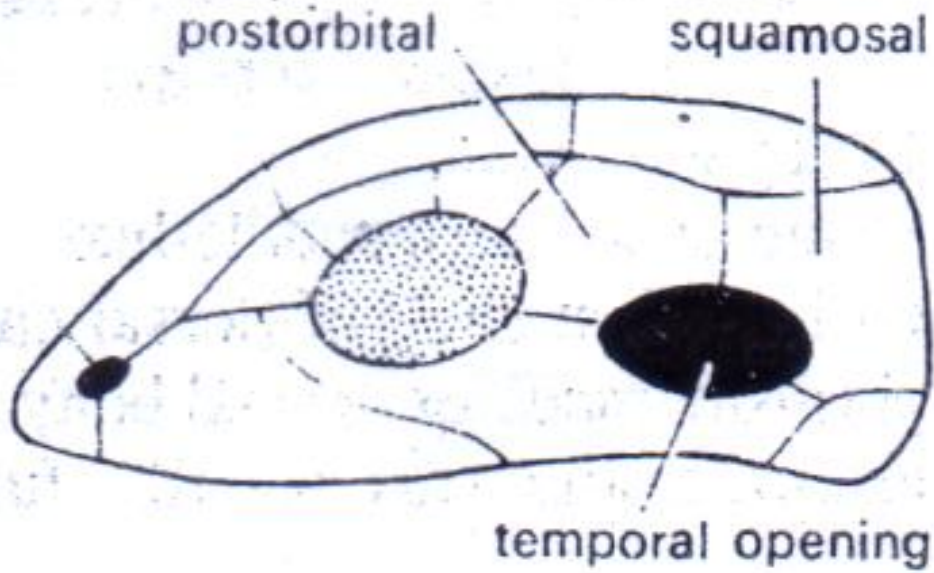
ANAPSIDA (stem reptile)



marine reptile plesiosaurs

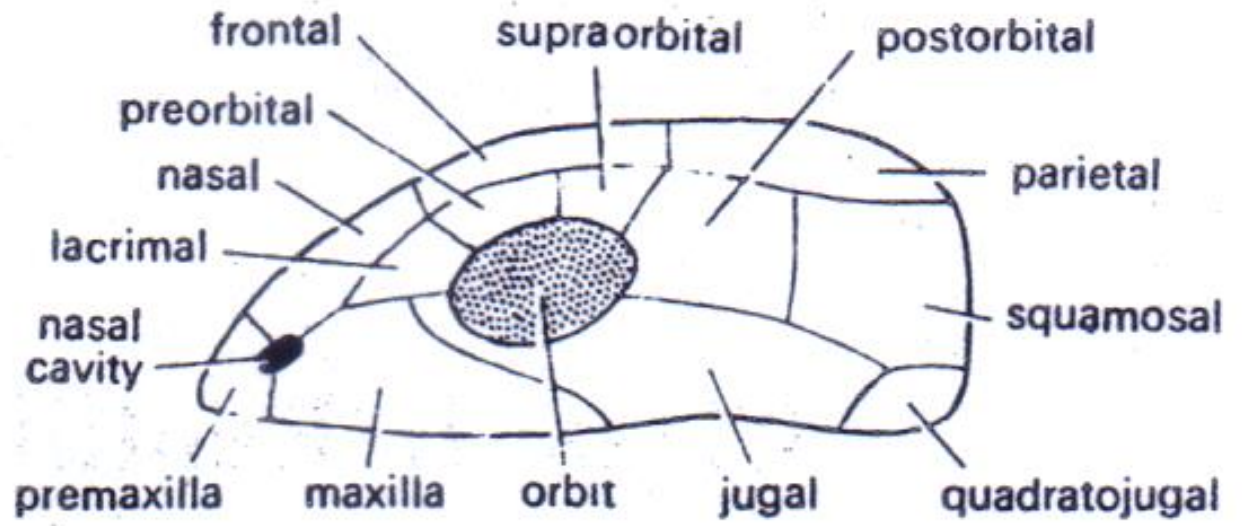


ANAPSIDA (stem reptile)

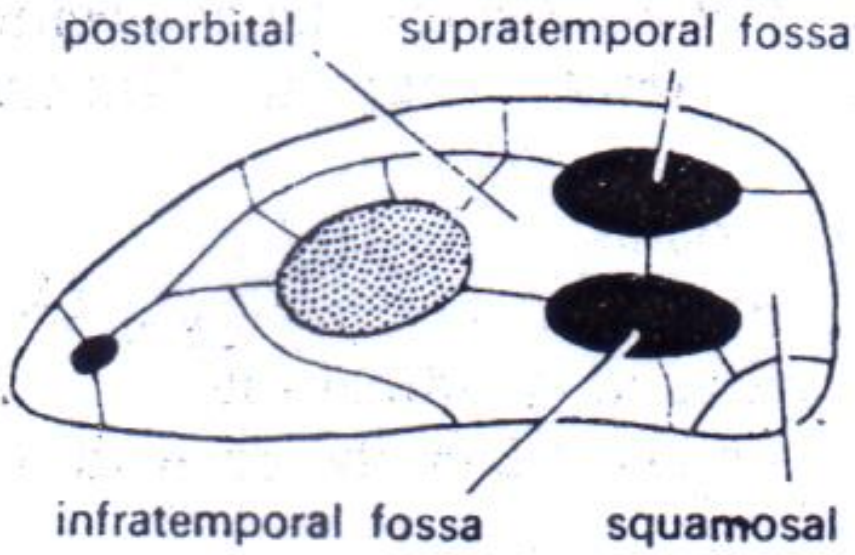


SYNAPSIDA (mammal stock)

Therapsid reptiles



ANAPSIDA (stem reptile)



DIAPSIDA (bird stock)

crocodiles, dinosaurs, flying lizards, sphenodons

Snake venom and anti venom

- Snake venom - secretions of modified salivary (Parotid) glands.
- Function- to immobilize the prey and aid in the digestive process.
- Otten (1998) classified Snake venom
 - as protein (90–95%) and non-protein (5–10%) compounds
- Composed- complex collection of
 - enzymes,
 - polypeptides,
 - glycoproteins
 - compounds of low molecular weight

- enzymes

- help to speed up chemical reactions (break chemical bonds between large molecules in prey)

- carbohydrates, proteins, phospholipids, nucleotides...etc.

- to lower blood pressure, destroy red blood cells and inhibit muscle control

- The different types/combinations of toxins found in snake venom
 - Neurotoxins - Paralysis of voluntary muscles
 - Haemotoxins - Destroy red blood cells
 - Coagulants - Cause blood clot in blood cells
 - Anticoagulants - Delay blood clotting
 - Cytotoxins - Destroy tissue
 - Hyaluronidase activity- Increase the spreading factor of the venom.
- Other types of Cytotoxins
 - Cardiotoxins damage heart cells
 - Myotoxins dissolve muscle cells
 - Nephrotoxins destroy kidney cells

Antivenom

Antivenin **or** venom antiserum **or** antivenom immunoglobulin

- Antivenom is a mixture of hyperimmune globulins and other proteins obtained from the serum of animals (**horses, sheep**) that have been immunized with the venom of a snake.
- Antivenoms can be classified into
 - monovalent (effective against a single species venom) or
 - polyvalent (effective against different species venom).
- Antivenoms bind to and neutralize the venom, halting further damage, but do not reverse damage already done.