ESTIMATION OF THE DISSOLVED OXYGEN IN THE GIVEN SAMPLES OF WATER

AIM: To determine the amount of the dissolved oxygen (DO) present in the given samples of water.

METHOD: WINKLER'S METHOD

INTRODUCTION: Oxygen is indispensable to the maintenance of life processes. It is an essential factor for the oxidation of energy rich compounds.

PRINCIPLE:

- When $MnSO_4$ is added to the sample of water to be analyzed, followed by strong alkaline iodide, manganous hydroxide is formed.
- $MnSO_4 + 2\ NaOH \longrightarrow Na_2SO_4 + Mn(OH)_2 \downarrow$
- This $Mn(OH)_2$ combines with dissolved oxygen present in the water sample forming manganic hydroxide.
- $4Mn(OH)_2 + O_2 + 2H_2O \longrightarrow 4Mn(OH)_3$
- On acidification with conc.H_2SO_4, the $Mn(OH)_3$ dissolves liberating nascent oxygen. This nascent oxygen oxidizes KI to iodine. The amount of iodine liberated is equivalent to the dissolved oxygen present. The iodine is then estimated by titrating it against standard $Na_2S_2O_3$ using starch as indicator.
- $2Mn(OH)_3 + 3H_2SO_4 + 2KI \longrightarrow K2SO_4 + 2MnSO_4 + 6H_2O + I_2 \uparrow$

APPARATUS: Reagent bottle, Burette, Pipette, Conical flask, measuring jar, Burette stand etc.,

REAGENTS: 40% $MnSO_4$, Alkaline iodide, 0.01N $Na_2S_2O_3$, Conc. H_2SO_4, 1%Starch

PROCEDURE:

- The volume of the reagent bottle is determined by measuring the volume of water with the stopper on.
- The reagent bottle is filled with the water sample to be analyzed temperature of the sample is noted down.
- With the pipette tip below the surface of water, 1 ml of 40% $MnSO_4$ and 1ml of alkaline iodide (KI in NaOH) are added.
- The stopper is fixed tightly making sure that air bubbles are not introduced.
- The reagent bottle is shaken thoroughly and the precipitate is allowed to settle down in a dark chamber for 10-15 minutes. The purpose of keeping the reagent bottle in dark chamber is to prevent photo-oxidation.
- After 15 minutes, the reagent bottle is removed out of dark chamber and 1 ml of conc.H_2SO_4 is added to it.
- The precipitate dissolves. In case the precipitate is not completely dissolved, little more conc. H_2SO_4 is added and usually not more than the quantity required to dissolve the precipitate.

- The burette is rinsed with distilled water first and then with $Na_2S_2O_3$. It is then filled with $Na_2S_2O_3$.
- 10ml of the treated water sample is taken from the reagent bottle into a clean, cry conical flask.
- 1or 2 drops of starch is added as an indicator and then titrated against $Na_2S_2O_3$.
- The end point is from light blue to colorless.
- From the tittered figures obtained, the amount of dissolved oxygen is calculated.

RESULT: The amount of dissolved oxygen in the given water samples at ---^{0}c was found to be as follows:

1. SAMPLE 'A'=DISTLLED WATER= ---------- cc/l
2. SAMPLE 'B'=TAP WATER=---------- cc/l
3. SAMPLE 'C'=POND WATER=---------- cc/l

DISCUSSION:

Oxygen dissolved in water, often referred to as DO, is a very important parameter of water quality and is an index of physical and biological processes going on in water.

There are two main sources of DO in water; i) diffusion from air and ii) photosynthetic activity within water.

Diffusion of oxygen from air to water is a physical phenomenon and depends upon the solubility of oxygen which in turn, is influenced by factors like temperature, air pressure, water movements, salinity etc.,

Photosynthetic activity is a biological phenomenon carried out by autotrophs and depends upon the autotroph population, light intensity, available gases etc.,

DO is considered to be an important limiting factor. It is subjected to greater fluctuations unlike the oxygen of terrestrial medium.

Thus, DO content is a variable abiotic factor of aquatic medium. Often, DO content varies in the same water sample at different temperatures. The DO content is high at low temperature and vice-versa. At higher temperature, due to evaporation of water, oxygen is freed into the atmosphere.

More DO is often recorded in distilled water than in freshwater and more so in freshwater than in sea water.

Higher salinity of the medium may decrease the DO, since the solubility of oxygen is low in waters of higher salinity.

The DO content may be lowered by respiratory activity of the biota of the ecosystem

TABULATION AND CALCULATION:

Volume of the reagent bottle ----------ml.

Temperature of the water sample ----------ml

Burette: 0.01N $Na_2S_2O_3$

Conical flask: Treated water+ Indicator

Indicator: 1% starch

End point: From Blue to Colorless

TITRATION TABLE:

SAMPLE →	DISTILLED WATER				TAP WATER				POND WATER			
BURETTE READINGS ↓	Sample A				Sample B				Sample C			
	T1	T2	T3	Average	T1	T2	T3	Average	T1	T2	T3	Average
F.B.R.												
I.B.R.												
VOL. OF $Na_2S_2O_3$ run down												
DISSOLVED OXYGEN (DO) IN cc/l												

FORMULA:

DISSOLVED OXYGEN IN THE WATER SAMPLE (CC/l) $= \frac{K \times 200 \times \text{Vol. of } Na_2S_2O_3 \text{ run down} \times 0.698}{\text{VOLUME OF THE SAMPLE}}$

$= \frac{1.02 \times 200 \times \text{Vol. of } Na_2S_2O_3 \text{ run down} \times 0.698}{10}$

$= \frac{1.02 \times 20 \times \text{Vol. of } Na_2S_2O_3 \text{ run down} \times 0.698}{}$

DO = ---------- cc/l.

Where:

$K = \frac{\text{Volume of the Reagent Bottle}}{[\text{Volume of the Reagent bottle}] - [\text{Volume of the reagents added}]}$

ESTIMATION OF SALINITY IN THE GIVEN SAMPLES OF WATER

AIM: TO DETERMINE THE AMOUNT OF SALTS PRESENT IN THE GIVEN SAMPLES OF WATER.

METHOD: MOHR'S METHOD

INTRODUCTION: Salinity is defined as the total amount of salt contents present in one K.G. of water.

Chlorinity is defined as the amount of chlorides, bromides and iodides in g, contained in one K.G. of water, assuming that bromides and iodides have been replaced by chlorides.

Salinity of water is an important factor in maintaining proper osmotic relationship between the protoplasm of an organism and water. Depending on the toleration range, organisms are broadly classified into STENOHALINE (cannot tolerate wide ranges of salinity) and EURYHALINE (have wide range of tolerance).

The salinity is also a variable ecological factor and may vary according to the various salts present in the medium.

PRINCIPLE:

- $AgNO_3$ running down from the burette reacts with chlorides present in the sample to be analyzed.
- All chlorides present in the sample get precipitated as AgCl.
- The addition of K_2CrO_4 gives a permanent pale precipitate of silver chromate which is permanently red in color
- $AgNO_3$+all chlorides in the sample $\longrightarrow$ AgCl+---NO_3
- $2AgNO_3+K_2CrO_4 \longrightarrow 2KNO_3+Ag_2CrO_4 \downarrow$
- Permanent brick red color
- In the beginning, the chloride ions are greater in the process than the chromate ions.
- Hence, this chloride combines readily with silver ions to form AgCl. Therefore AgCl is precipitated.
- Later in the experiment, free silver ions are available to combine with chromate ions (as all the chloride ions have already got precipitated) and therefore it gets precipitated with chromates ions to give a brick red precipitate.

APPATARUS: Burette, Pipette, Conical flask, Beakers, Burette stand *etc.,*

REAGENTS: 0.005 N $AgNO_3$, K_2CrO_4

PROCEDURE:

- The burette is rinsed first with distilled water and then with $AgNO_3$. It is then filled with $AgNO_3$.
- Initial reading of the burette is noted down.
- 10 ml of the water sample to be analyzed is pipetted out into a clean, dry conical flask.
- 2 drops of K_2CrO_4 indicator is added to the conical flask containing water sample and is titrated against $AgNO_3$ till the yellow color just disappears and turns to permanent pale brick red.
- The final burette reading is noted down.
- The titration is repeated to get concordant values.

RESULTS: The amount of salts present in the given water samples was found to be as follows:

1. Sample A = Distilled Water= ---------- g/l
2. Sample B = Tap Water= ----------g/l
3. Sample C = Pond water=---------- g/l

DISCUSSION:

The salinity of given water sample largely depends on the source of collection. Water samples from different sources exhibit variations in their salt contents. Water sample subjected to distillation process is expected to contain no or least amount of salts in it. The tap water comparatively shows higher amount of salt contents due to the presence of various minerals. The fluctuations in pond water are largely attributed to various biotic-abiotic interactions taking place in it. However, the salt content in different water samples also depends on the other ecological factors like dissolved oxygen, temperature etc.,

TABULATIONS AND CALCULATIONS:

TITRATION TABLE:

BURETTE: 0.005N $AgNO_3$
CONICAL FLASK: Water sample
INDICATOR: 2% K_2CrO_4
END POINT: Yellow to permanent pale brick red color.

SAMPLE →	DISTILLED WATER				TAP WATER				POND WATER			
BURETTE READINGS ↓	Sample A				Sample B				Sample C			
	T1	T2	T3	Average	T1	T2	T3	Average	T1	T2	T3	Average
F.B.R.												
I.B.R.												
VOL. OF $AgNO_3$ run down												
NORMALITY												
CHLORINITY												
SALINITY g/l												

CALCULATIONS:

I. NORMALITY:

$(V1N1)_{H2O} = (V2N2)_{AgNO3}$

$N1 = \frac{V2N2}{V1} = \frac{X \times 0.005}{10}$

V1 = Volume of water sample taken = 10 ml

N1 =Normality of water=?

V2 =Volume of $AgNO_3$ rundown= X

N2 =Normality of $AgNO_3$ = 0.005N

II. Chlorinity = Normality of water X Equivalent weight of Chlorine (35.5)

= ----------X 35.5 =----------g/l

III. Salinity= 0.03+ [1.805 X Chlorinity] = ---------- g/l

ESTIMATION OF DISSOLVED ORGANIC MATTER IN THE GIVEN SAMPLE OF WATER

AIM: TO DETERMINE THE AMOUNT OF DISSOLVED ORGANIC MATTER PRESENT IN THE GIVEN SAMPLE OF WATER

PRINCIPLE: Nascent oxygen released by acidified $KMnO_4$ reacts with the dissolved organic matter present in the sample. The remaining oxygen is estimated titrimetrically which indicates the amount of dissolved organic matter present in the sample given.

$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4+2MnSO_4+3H_2O+5(O)\uparrow$

REAGENTS: Std.$MnSO_4$, 1:3 dilute H_2SO_4, 0.1N $Na_2S_2O_3$, Saturated KI, 1%Starch and Permanent pale pink H_2SO_4.

PROCEDURE:

- 100ml of the given water sample is taken in a clean 250ml reagent bottle, which is previously rinsed with conc.H_2SO_4.
- To this 10 ml of permanent pale pink H_2SO_4 is added followed by the addition of 10 ml of $KMnO_4$.
- The reagent bottle is kept in dark chamber for about 15 minutes and the reaction is allowed to take place.
- After 15 minutes, drops of saturated KI are added to the reagent bottle till the solution turns yellow. The bottle is shacked thoroughly.
- 25ml of the above solution is titrated against 0.1N $Na_2S_2O_3$ using starch as indicator.
- A blank titration using distilled water instead of sample is carried out.

RESULT: Amount of oxygen required to oxidize the dissolved organic matter present in one liter of sample of water was found to be ----------ml of O_2/l.

DISCUSSION:

- Determination of the amount of dissolved organic matter in any given sample water forms one of the important aspects of “chemical analysis of water”.
- The amount of dissolved organic matter seldom remains same in different water samples.
- In distilled water, the dissolved organic matter is hardly present as it is devoid of biotic components.
- Unlike distilled water, tap or pond water do contains organic matter. Because of the dense abiotic-biotic interaction, plenty of dissolved organic matter is expected to be present in the pond water sample.

- The amount of dissolved organic matter varies not only from pond to pond, but also in different strata of the same pond.
- The 'HYPOLIMNION' (bottom region) exhibits greater amounts of dissolved organic matter as more of dead and decaying matter is found here, accompanied by the ongoing decomposition by decomposers and transformers.
- Sometimes,' EPILIMNION' (surface strata) of lentic ecosystems may contain less amounts of dissolved organic matter when compared to the same of lotic ecosystems.
- The excretory wastes of the consumers and the remains of dead organisms add to the quantity of dissolved organic matter.

To conclude, the amount of dissolved organic matter present in the given water sample depends on the following factors.

1. Dissolved oxygen content.
2. Other dissolved gases like CO_2 etc.,
3. Density of decomposers and transformers.
4. Faunal and floral diversity of the pond ecosystem.
5. Salinity of the water sample
6. Temperature etc.,

TABULATION AND CALCULATION:

TITRATION TABLE:

SAMPLE →	SAMPLE WATER				BLANK (DIST.WATER)			
BURETTE READINGS ↓	T1	T2	T3	Average	T1	T2	T3	Average
F.B.R.								
I.B.R.								
VOL. OF $Na_2S_2O_3$ run down								
AMOUNT OF OXYGEN REQUIRED TO OXIDISE THE ORGANIC MATTER PRESENT (ml of O_2/l)								

BURETTE: 0.1N $Na_2S_2O_3$

CONICAL FLASK: TREATED WATER SAMPLE

INDICATOR: 1% STARCH

END POINT: BLUE TO COLOURLESS

CALCULATIONS:

1.2 ml of $Na_2S_2O_3$ ==========1 ml of O_2/l

X - ml of $Na_2S_2O_3$ ========== $\frac{X \times 1}{1.2}$

For water sample :_____ml of O_2/l

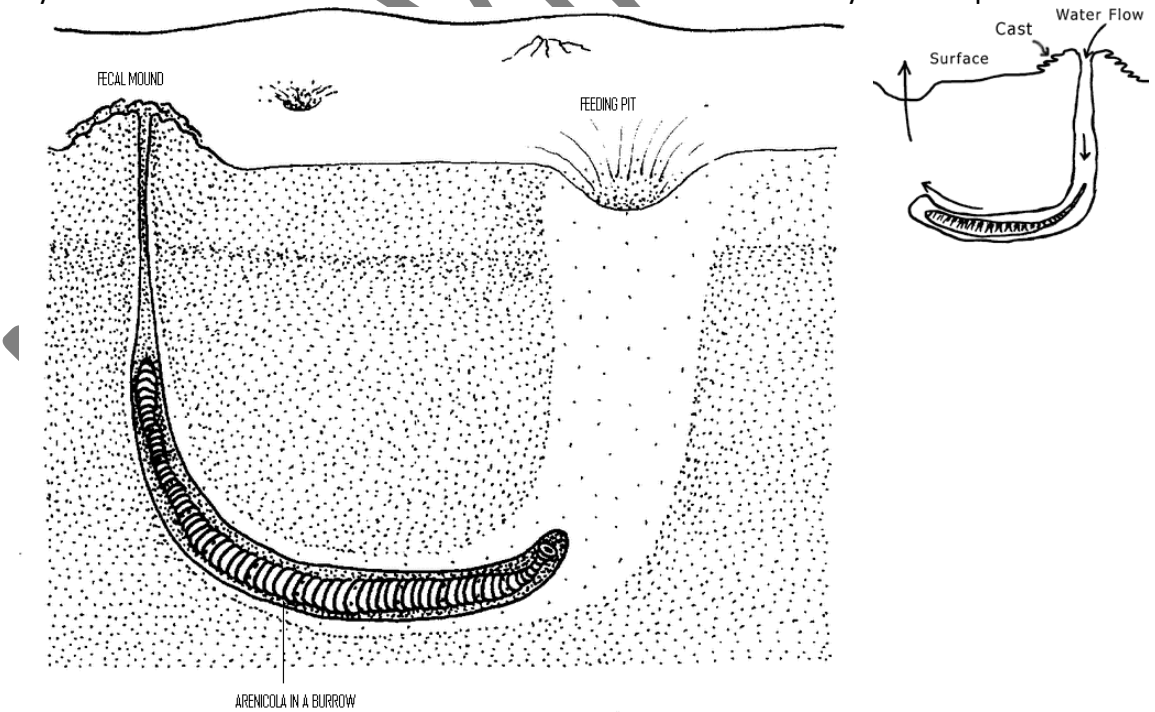
For blank :_____ml of O_2/l

Therefore Dissolved Organic Matter Present :_____ml of O_2/l
the given water sample

ECOLOGICAL ADAPTATIONS

IDENTIFICATION: <u>ARENICOLA</u> (Lug/ Lobe worm) - TUBICULOUS FORM
COMMENTS

- Arenicola is a marine, tubiculous and burrowing sedentary polychaete which lives in 'J' or 'U' shaped tubes.
- Tubes are made of sand in inter-tidal sandy seashore and eulittoral zone. This tube offers protection and living ground and are lined with mucous to prevent its collapse.
- Tube dwelling habitat helps them conserve water, avoid dessication, withstand isolation, evaporation and escape from the impact of waves and enemies.
- Body is elongated, has three regions namely anterior, middle and posterior. Eyes and tentacles are absent in anterior region. Anterior region has hook like uncinate cetae which provides grip.
- Anterior region has: a small trilobed prostomium, a peristomium and six segments bearing chaetae and parapodia.
- Mouth lies ventral to prostomium. The buccal region and pharynx protrude as proboscis. The proboscis is used for feeding and locomotion. Eversible pharynx has minute papillae which help in feeding and digging.
- Arenicola burrows into the sediment using its proboscis and also by muscular contractions of the first few segments. The peristalic waves of the body wall helps in penetration, irrigating the burrow and also in terminal anchor of tubes.
- The beating of parapodia also helps in creating currents of water in 'U' shaped tubes which helps in feeding and respiration.
- Gills present on the sides of the middle region are branched and highly vascularized which is an important adaptation for life in a burrow.
- It ingests sediment at head end of the burrow forming a feeding coloumn and funnel on the surface. Water enters the tube from funnel like depression percolating down through sand which filters suspended detritus and plankton and feeds on the material obtained.
- It can remain in a period of suspended activity for a longer time. It is a euryhaline and eurythermal animal and can overcome wide fluctuations of salinity and temperature.

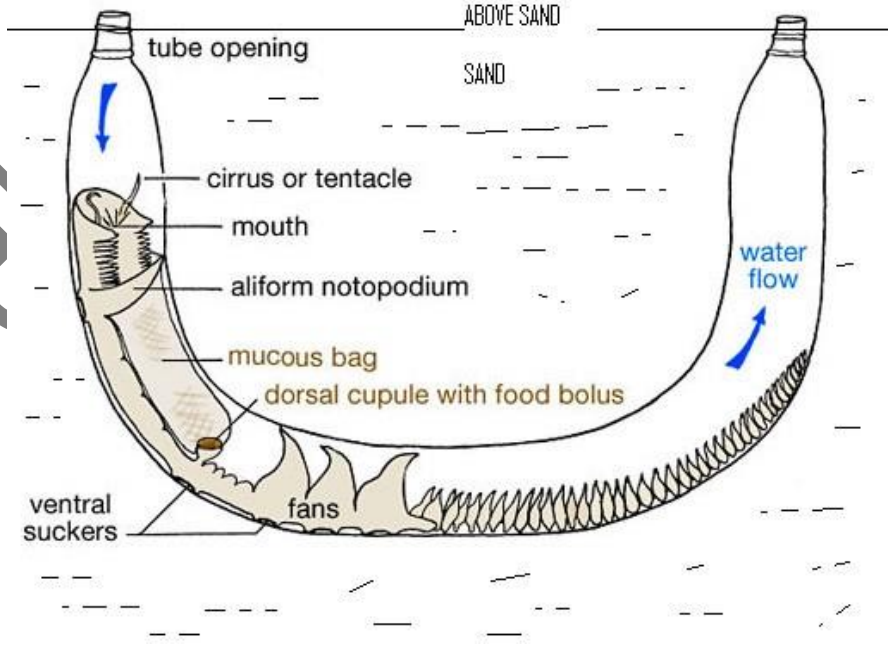


<u>ARENICOLA</u>-TUBICULOUS FORM

IDENTIFICATION: CHAETOPTERUS (Paddle worm) - TUBICULOUS FORM

COMMENTS

- Chaetopterus is a marine tubiculous polychaete living in inter-tidal sandy seashore and eulittoral zone in 'U' shaped tubes with two apertures. The tubes are made up of sand, mud and debris.
- As the worm grows a slit is generated in the tube with the spines located on one of its segments. Then more material is added to expand both length and width wise. Both ends of the tube project outside the sediment surface. To prevent the tubes from getting washed away by the shore currents, the tube is often coated with mucous and fine mud.
- Tube dwelling habit helps them to conserve water, to avoid dessication, evaporation and to escape from the impact of waves and enemies.
- The body is having three regions namely anterior, middle and posterior.
- The anterior region is flat and bears nine pairs of simple parapodia and mouth. Paddle like structures are found on the middle segments which are used for pumping water through the tube. They help in creating currents of water.
- Mouth is wide and funnel shaped. This helps in receiving small worms that enter the tube.
- The entire body secrets slime which lines the tube and also covers the body.
- Chaetopterus is a filter feeder. The ciliated groove and food cup present in the anterior region help in trapping the food particles.
- Notopodia of segments 14-16 forms three fans. The rhythmic flapping of muscular fans maintains water current which brings in oxygen and carries waste. Water enters through one end of the burrow and leaves through other end.
- The wing like aliform notopodia form fans which help in holding the body within the tube.
- The ventral surface of the body is fixed to the tube by suckers.
- The neuropodial setae help the animal to move inside the burrow.
- The tube dwelling habit has made the body of chaetopterus soft.
- It is known for 'bioluminescence'. Its mucus when dispersed in water emits bluish-green light.

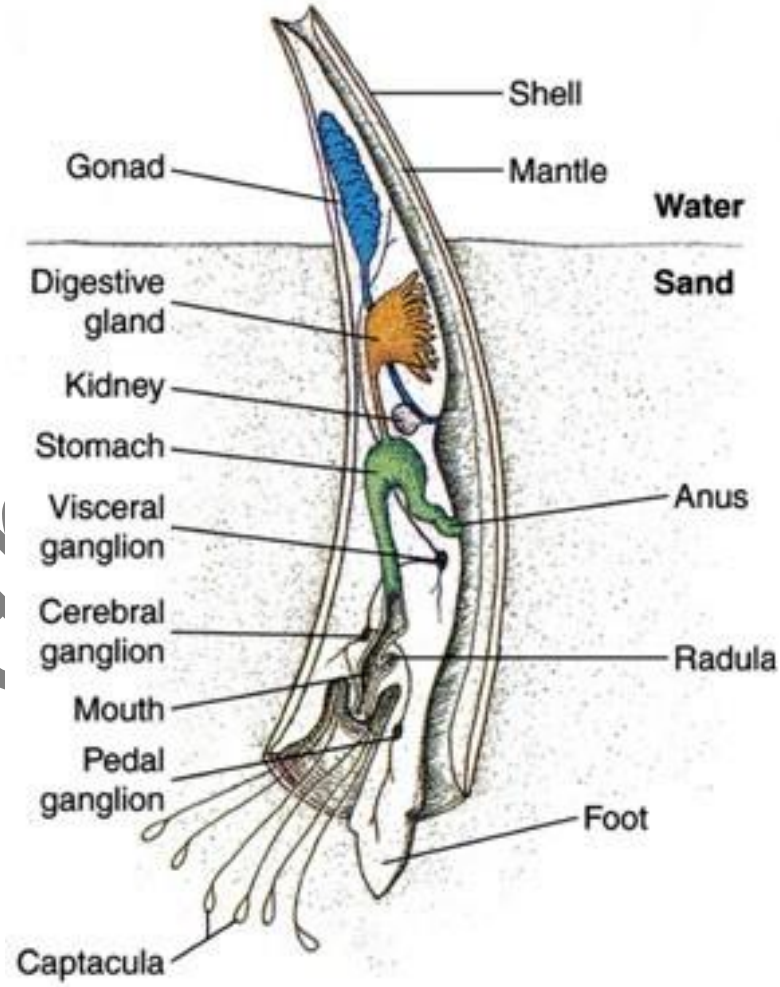


CHAETOPTERUS - TUBICULOUS FORM

IDENTIFICATION: <u>DENTALIUM</u> (Elephant tusk shell) - BURROWING FORM

COMMENTS

- It is a marine, burrowing mollusc found in the sand at great depths.
- Body is enclosed in a shell which protects the soft body of the animal. Shell is cylindrical, tubular, slightly curved and tapering. It has longitudinal ridges and is open at both the ends. It measures about 2-5cms.
- The animal lives burried in the sand with the head downwards. Body is sharply inclined. The small posterior aperture projects above the surface. Burrowing mode of life gives protection against the action and force of waves.
- The foot is muscular, long, cylindrical and trilobed. It protrudes through the anterior opening of the shell and has wing like ridge on either side. The foot is used for burrowing in the sand. It is fully extended when lodged with blood, plugs deep into mud and draws the animal into the burrow by subsequent contraction.
- The apex of the shell remains above the sand surface through which water enters for respiration and exits through the exhalent siphon.
- The head is proboscis like. From the dorsal side of the head arise a number of extensible filaments with sucker like ends called captacula. They serve as sense organs, for seizing the food and respiration.

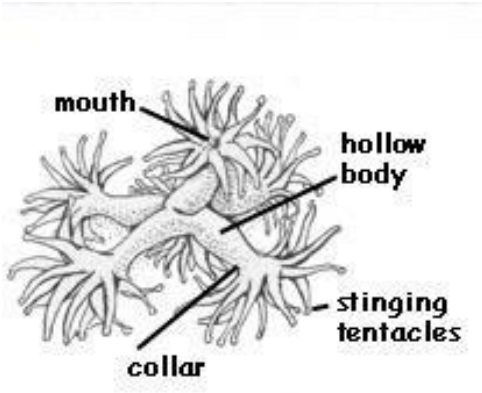


<u>DENTALIUM</u> - BURROWING FORM

IDENTIFICATION: <u>SEA ANEMONE</u> - SEDENTARY FORM

COMMENTS

- Sea anemone is a marine, solitary, brightly coloured flower like polypoid coelenterate lives in shallow water (littoral zone).
- Body is short, cylindrical, muscular and radially symmetrical and has three divisions: namely proximal pedal disc, middle column scapus and distal oral disc.
- Pedal disc is muscular, expanded and is used for anchoring the animal to rocks, shells or substratum but can glide over the substratum. Basal disc gets attached to the substratum with the help of sticky secretions.
- Body is elastic, highly contractile; it increases and decreases its length to catch the prey.
- It can creep by gliding motion of the pedal disc. It adheres by mucus secretion and by muscles of the pedal disc.
- Distal end is expanded into a flat oral disc which is crowned with several marginal tentacles around the mouth. The tentacles have batteries of nematocysts which help in offence and defence.
- The column bears numerous openings called Cinclide through which the Acontia emerge out to help in food collection and defense.
- When disturbed, sea anemone can withdraw its oral disc completely and shrinks to form a mound. The animal produces an offensive odour to keep away from the enemies.

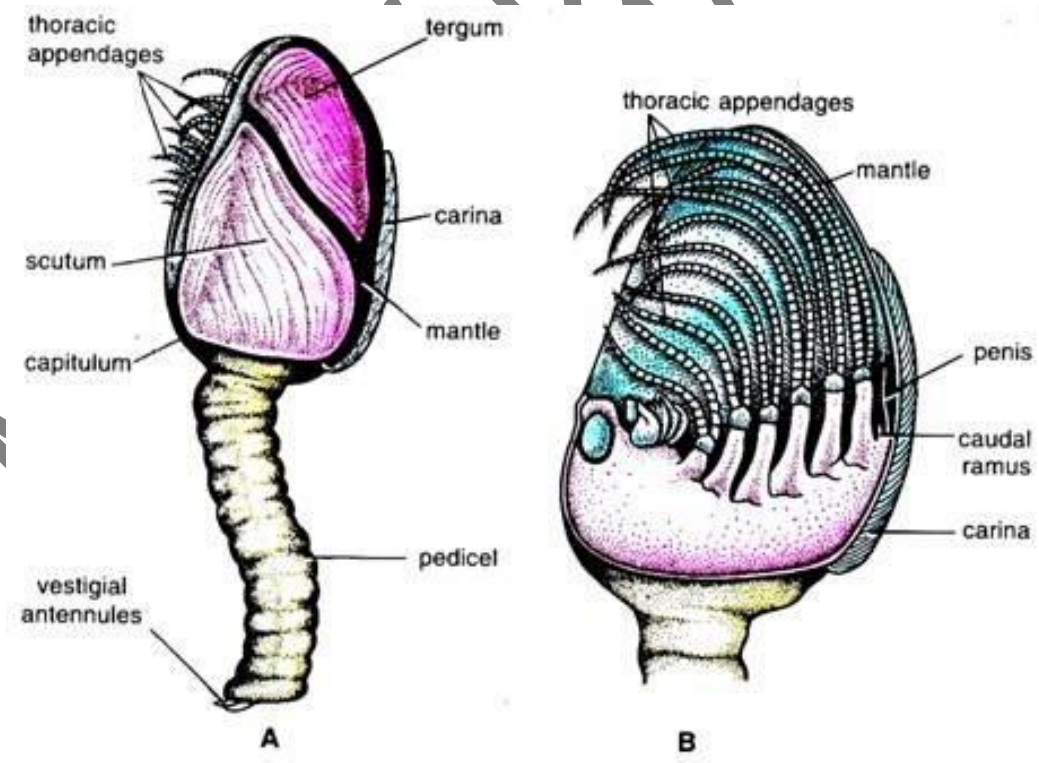


<u>SEA ANEMONE</u> - SEDENTARY FORM

IDENTIFICATION: LEPAS (GOOSE OR SHIP BARNACLE) - SEDENTARY FORM

COMMENTS

- It is present in balanoid zone of sandy or muddy shores of eulittoral zone.
- Body has a long stalk or peduncle. It contains cement gland whose secretion helps in attachment.
- Body proper is present at distal end of pedicel. It is called capitulum protected by bivalved carapace.
- Carapace is strengthed by 5 large calcareous plates.
- Shell helps them to withstand isolation, evaporation, dessication and also protects from action of waves and enemies.
- Becuse of sedentary life, they have lost the locomotory organs.
- Head is reduced, paired eyes are absent. Thoracic appendages are well developed and fringes with tuft of setae which creates water current to draw small organisms towards the mouth.
- The animal feeds on minute organisms which are kicked into the mouth with its feet.
- Lepas has an efficient adaptation for conservation of water. The shell is tightly closed, when they are exposed to air for protection. An air bubble is frequently enclosed between them. This serves as an additional source of oxygen.
- They have developed rapid power of contraction when conditions are unfavorable.
- They have ability to remain in a condition of suspended activity for a longer period. It is a remarkable feature of shore animal.
- It is euryhaline and eurythermal animal to over come the wide fluctuations of salinity and temperature.
- It is hermophrodite, presence of free swimming nauplius and cypris larva is essential for a fixed adult for it brings about the dispersal of species.

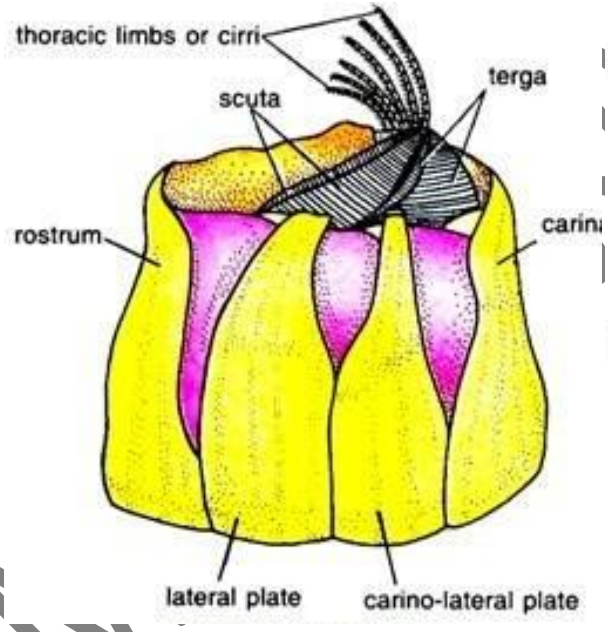


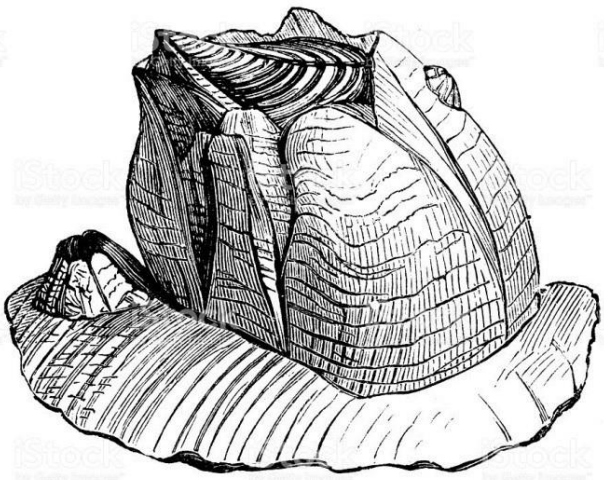
LEPAS - SEDENTARY FORM (A-Whole Animal, B-Carapace removed)

IDENTIFICATION: <u>BALANUS</u> (Rock Barnacle)- SEDENTARY FORM

COMMENTS

- Its pyramid like, peduncle is absent, sessile attached to rocks by basis. Basis represent pre oral region, contain cement glands which helps the balanus to attach its self to rocks.
- The whole animal is surrounded by calcareous shell formed of 6 overlapping plates. Unpaired Carina, unpaired Rostrum, two pairs of lateral plates, which help them to withstand isolation, evaporation, dessication and also protects it from the action of waves and enemies.
- The opening of the shell is closed with a four fold covering two Scuta and Two Terga.
- 6 pairs of thoracic legs are protuded out through the opening of shell and sweep food particles.
- Because of sedentary life they have lost locomotor organs.
- Balanus has an efficient adaptation for conservation of water. The shell is tightly closed when they are exposed to air for protection. An air bubble frequently enclosed between them serves as an additional source of oxygen.
- They have ability to remain in a condition of suspended activity for a longer period. It's a remarkable feature of shore animal.
- It's a euryhaline and eurythermal animal to over come the wide fluctuations of salinity and temperature.





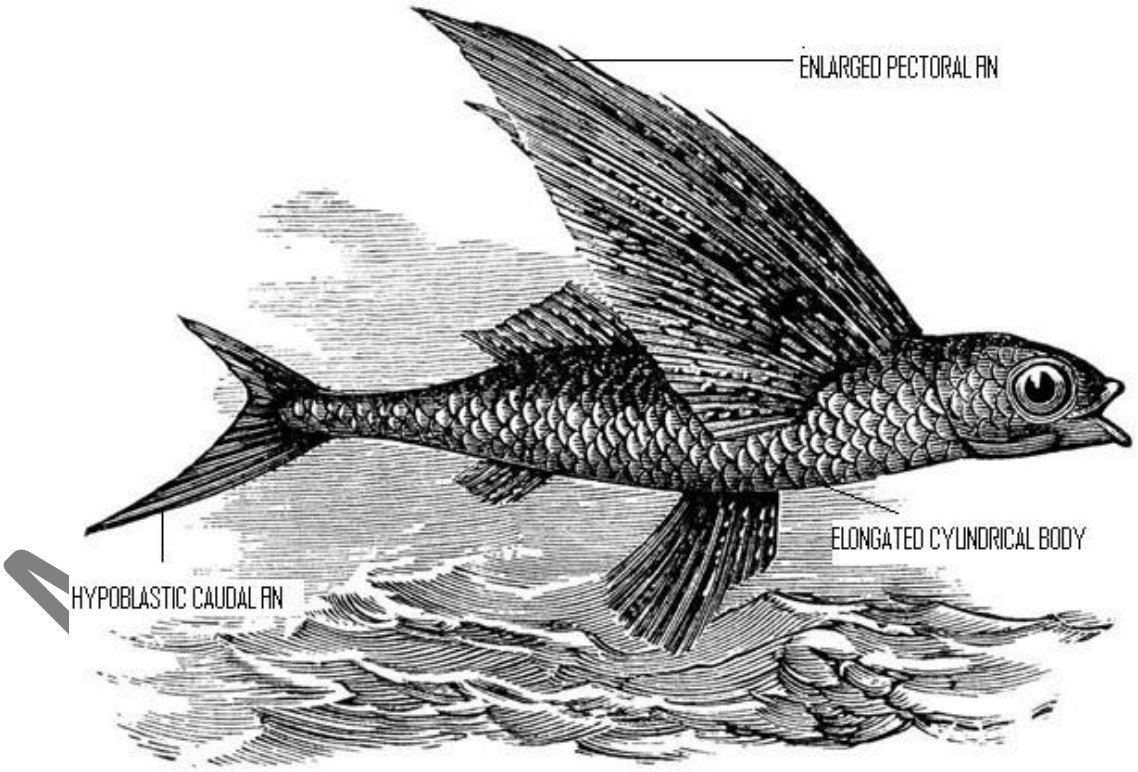
<u>BALANUS</u> - SEDENTARY FORM

PASSIVE FLIGHT ADAPTATIONS COMMENTS

During passive flight, the animal takes a leap from a high point and progresses slowly towards a low point covering a certain horizontal distance. For this the organism requires an initial force to take off. The rest of the distance is covered by the animal being retained in the air, with the aid of the sustaining membrane which need not be moved.

IDENTIFICATION: <u>EXOCOETUS</u> (flying fish) – PASSIVE FLIERS

- Marine form found in tropical and subtropical sea. Body covered by overlapping cycloid scales.
- The Pelagic fish shows passive flight adaptation for survival and predation. It has elongated, pectoral fins which are exceptionally large, spread like wings and inserted highly on the body. It helps in gliding for short distance in air over the surface of water before re-entering water. It can glide 200-300 yards when there is favourable wind speed and 400-500 yards when it is strong.
- Pectoral fins are enlarged and used as parachute for the fish to leap outside the water. They vibrate rapidly beating about 50times/second.
- Pelvic fins are also adopted to lift the body out of water.
- Tail is hypoblastic. Ventral lobe of caudal fin is large and strong by its powerful stroke the fish leaves water with force and can accelerate the speed if the course of flight is near the water surface.

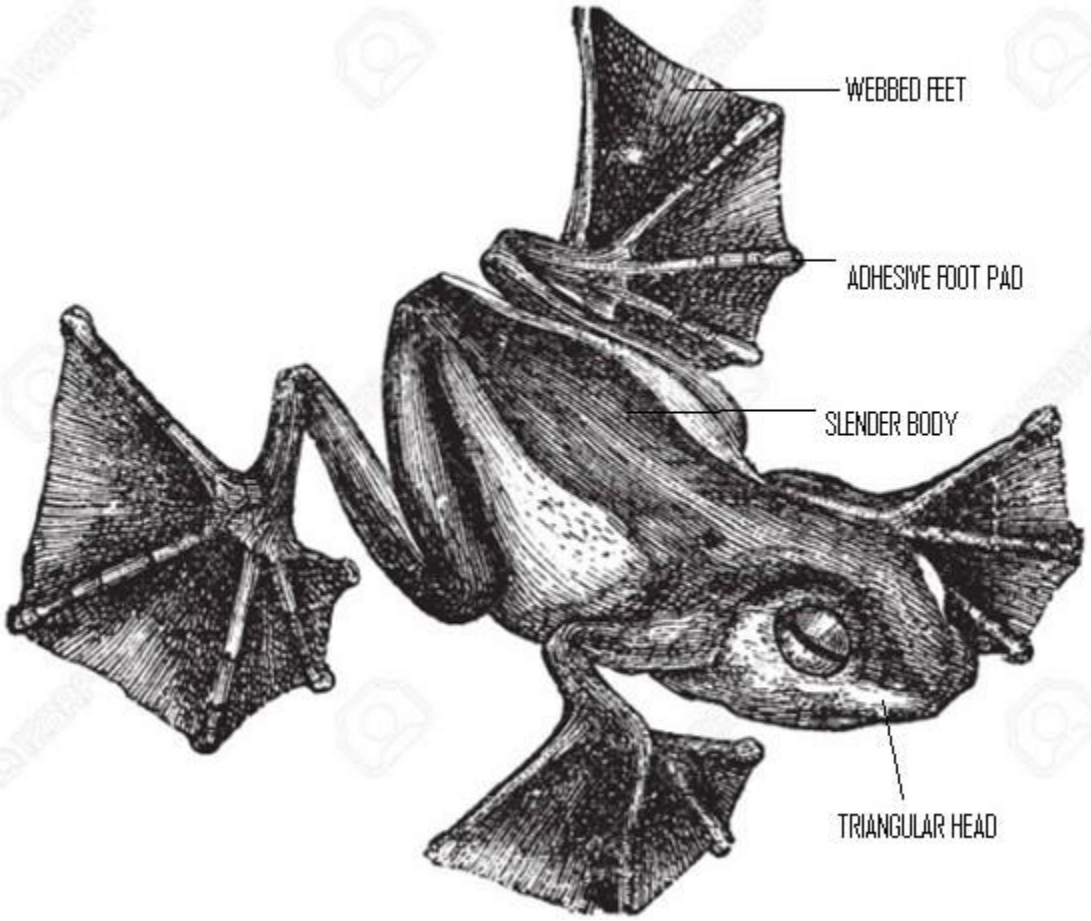


<u>EXOCOETUS</u>– PASSIVE FLIERS

IDENTIFICATION: RHACOPHORUS (flying frog) – PASSIVE FLIERS

COMMENTS

- It is modified for aerial or volant mode of life which is of survival value.
- Body is slender and limbs are elongated, which offers no resistance to propel the body through the air.
- Head is broad and some what conical in shape. Eyes with eyelids are well developed.
- The belly narrows posteriorly, which helps in gliding.
- Both forelimbs and hindlimbs contain well developed webs in between digits. The expanded web helps the animal to have a prolonged leap. The digits also bear adhesive cushions at the tips to help in easy landing and climbing trees as well.
- The flying frogs climb on trees and walls and occasionally glide in the air. During passive flight the webs are spread like parachute.
- Rudiments of skin fold are found in front as well as behind the arms which may assist in gliding.



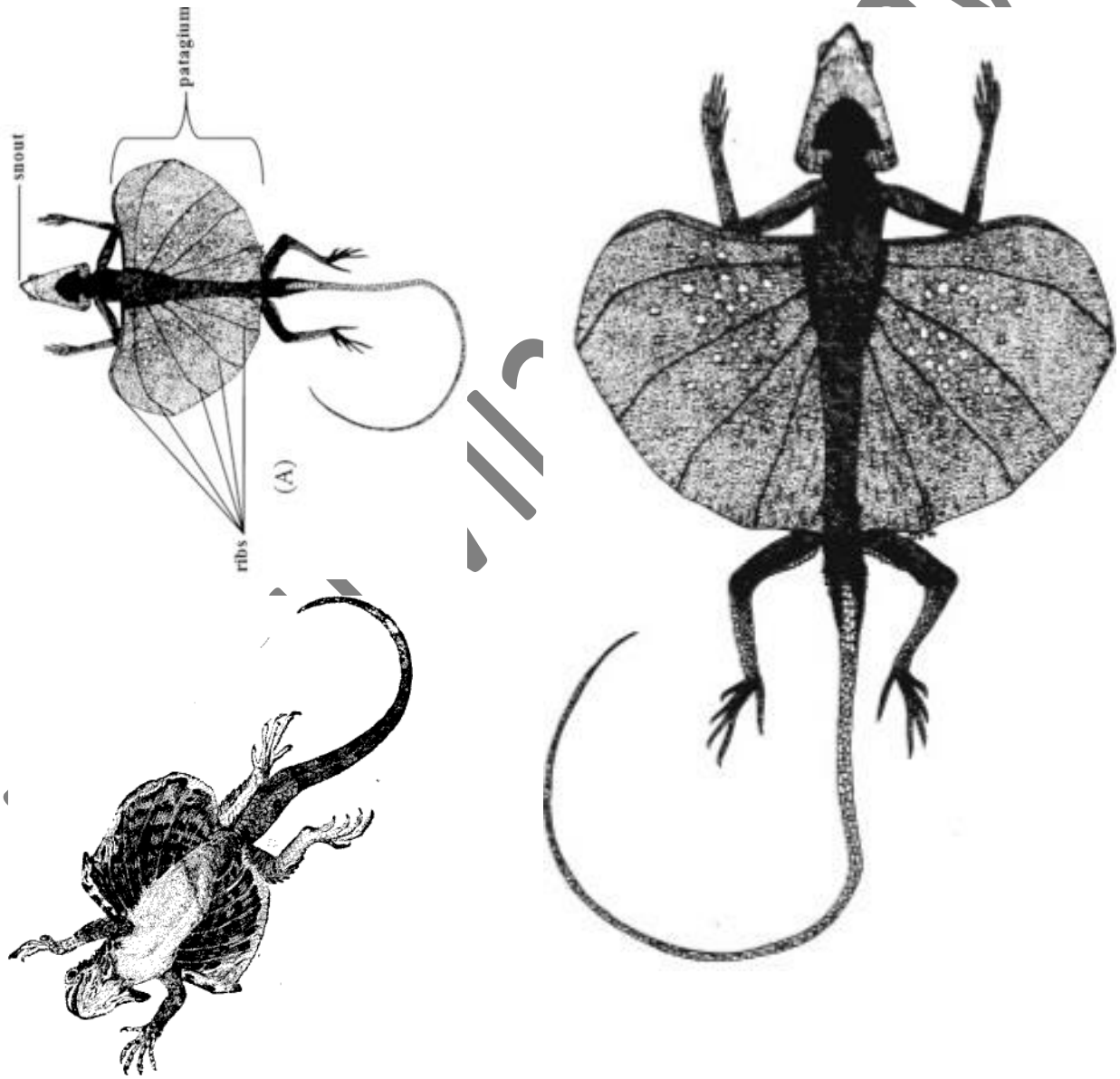
RHACOPHORUS – PASSIVE FLIERS

IDENTIFICATION: <u>DRACO</u> (flying lizard) – PASSIVE FLIERS

COMMENTS

The body is modified for climbing and gliding from higher to lower branches adapted for arboreal life, to escape from the enemies.

- Body is dorso ventrally compressed, measures 15 to 22 cm in length. It has head neck, trunk and a long tapering tail.
- 2 - 3 hooks are present on ventral side of neck, which helps the animal in anchoring to twigs.
- The skin of the abdomen is extended laterally between the forlimbs and hindlimbs. It is supported by 5-7 pairs of patagial ribs called Patagia.
- When the ribs are raised, the skin is stretched to form wing like patagia which enable the lizard to glide. The Patagia can be folded against the body when not in use.
- It is brilliantly colored and exhibits camouflagy.

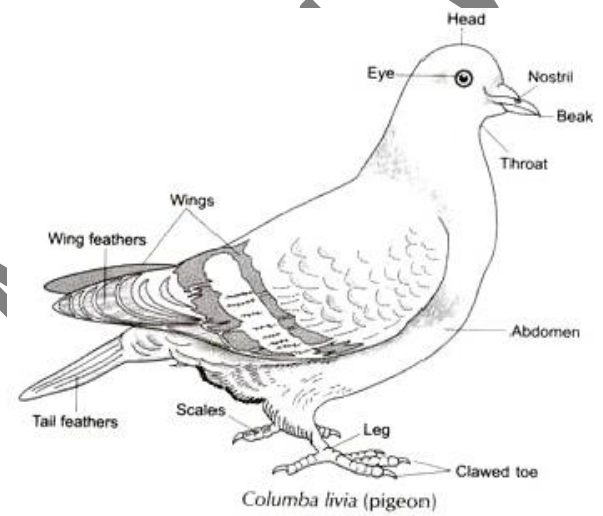


<u>DRACO</u> – PASSIVE FLIERS

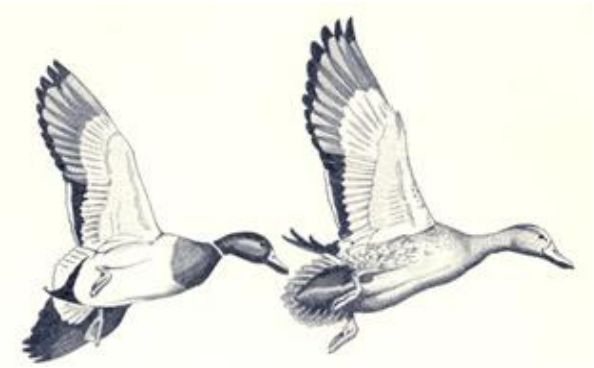
IDENTIFICATION: <u>BIRD</u> - ACTIVE FLIER

COMMENTS

- Body is streamlined with an exoskeleton of feathers, to move through air with least resistance.
- Reduction in body weight is achieved by modifications like feathers, pneumatic bones, fusion of skull bones, absence of teeth and jaws forming a beak, absence of sweat glands, tail replaced by tail feathers.
- Fore limbs are modified into wings, each bearing three clawless digits and provided with feathers for flight.
- The hind limbs are strong, adapted for walking, perching or swimming. Hind limbs bear four toes.
- Skull is monocondylar with single round occipital condyle for flexible neck to compensate for the modification of forelimbs for flight.
- Broad sternum, usually with a longitudinal ventral keel for the attachme t of flight muscles. The clavicles of the pectoral girdles are fused to form V shaped Furcula which keeps the wings apart during flight.
- The muscular system is well developed. The flight muscles pectoralis major, pectoralis minor and coracobrachialis control the wing movements.
- Feeds on nutritious food for rapid energy supply. Gullet is dilated into a crop.
- Lungs are spongy and non-distensible. Air sacs are present and some of them communicate with air cavities in the bones. This helps in storing more air and also cools the body.
- Heart is four chambered. Only right aortic arch is present in the adult. val, nucleated and biconvex RBcs. Efficient double circulation for homeothermy.
- Left overy alone is present. Right ovary is almost atrophied to reduce body weight.
- Presence of efficient kidneys and absence of urinary bladder. Birds are URICOTELIC animals.
- Eyes have Pecten that increases the ability to see far and near objects.



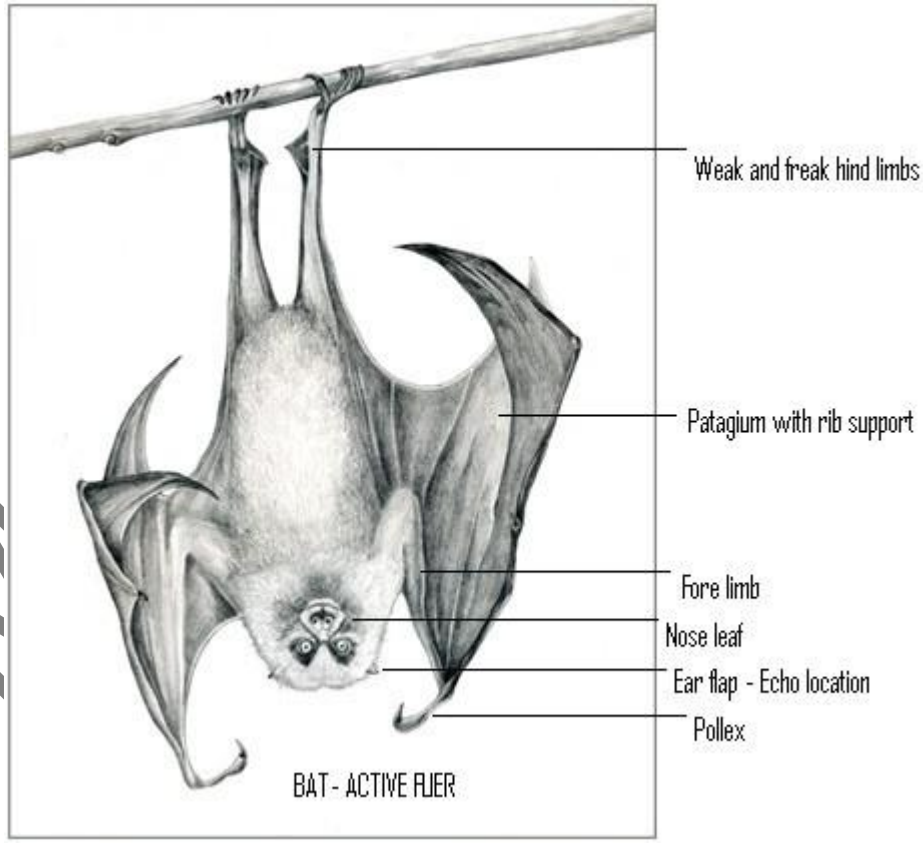
Columba livia (pigeon)



IDENTIFICATION: <u>BAT</u> - ACTIVE FLIER

COMMENTS

- These are the only mammals adapted for active flight.
- Their small body is covered with fur.
- Large pinnae with flaps serve as tactile structures and make hearing more acute.
- Small eyes with weak vision as the visual rods are poorly developed. They produce ultrasonic sounds and find their path by ECHOLOCATION mechanism. Nocturnal in habit.
- Hind limbs are weak and used to hang upside down clinging on to tree branches. The day time is spent in dark places and during dark they come out for feeding.
- Presence of patagia on either side of the body, starting on the upper side of the shoulder, above the fore limb, passing between the digits, on the lower side of the arms and extending between the limbs and end as interfemoral membrane between the thighs. The forelimb skeleton is modified to support the patagia.
- The pectoral muscles are well developed to aid in flight.
- Bones are pneumatic. Sternum is produced to keel.
- All the fingers are elongated except the thumb which is not included in the patagium. It bears claw for crawling and climbing.
- Hindlimbs are weak and free with five clawed digits.
- Short snout with or without nose leaf.



<u>BAT</u> - ACTIVE FLIER

ANIMAL ASSOCIATIONS

IDENTIFICATION: PHYSALIA (Portuguese man of war) - COLONIAL FORM

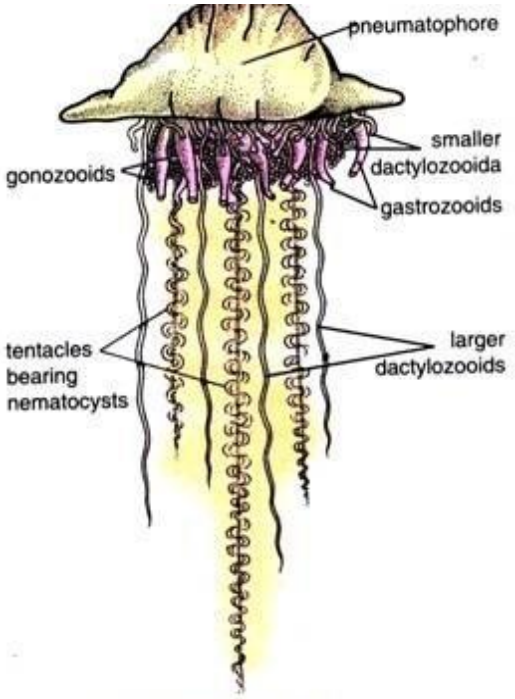
COMMENTS

- Physalia is a marine pelagic, polymorphic (the polymorphic colony consists of several 'zooids' which perform different functions so as to enable 'division of the labour') coelenterate colony found floating or swimming on the surface of tropical and sub-tropical oceans.
- It has a large gas-filled pneumatophore (float) which floats above the surface of water. It provides bouyancy for the animal.The bladder like float is elongated and is pointed at both the ends. It is dorsally produced into 'sail'or 'crest'.
- A gas gland is present inside float which secretes gas whose composition is similar to that of air, enabling the colony to float.
- Beneath the float are hanging down the three types of zooids:

Gastrozooids are tubular with a mouth and a long tentacle may be present. These are nutritive zooids

Gonozooids are branching blastostyles having leaf like gonopalpons, male and female medusae (gonophores). These are reproductive zooids.

Dactylozooids are of various sizes. Each is a tubular mouthless individual with a long tentacle having strong muscles and twisting ribbon of nematocysts. These are protective in function. Thus the polymorphism exhibited aptly suits the division of labour.



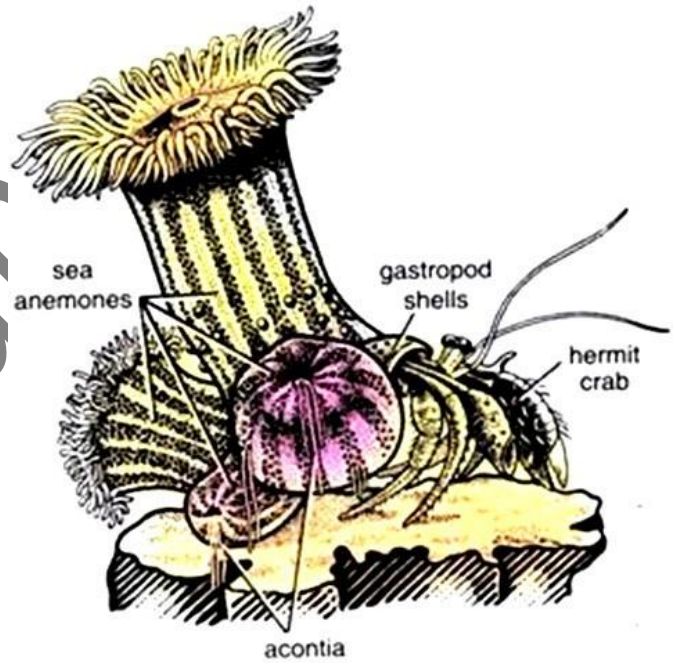
PHYSALIA - COLONIAL FORM

IDENTIFICATION: <u>HERMIT CRAB WITH SEA ANEMONE</u> - FACULTATIVE MUTUALISM

COMMENTS:

The interaction between two organisms, where both are benefitted is called MUTUALISM. FACULTATIVE MUTUALISM refers to a condition where; when the two organisms live together mutually they are benefitted although both are capable of leading an independent life.

- Sea anemone, *Adamsia pallicata,* is a sedentary form. It belongs to phylum Coelenterata and class Anthozoa. The lobed pedal disc helps in anchorage.
- Hermit crab, *Eupagurus prideauxi*, belongs to phylum Arthropoda, and class Crustacea.
- It is a peculiar crustacean showing extreme modifications in order to accommodate itself in the coils of molluscan (gastropod) shells. As it grows bigger; it shifts to a larger shell.
- Carapace is highly reduced and the soft body covered with a soft cutilcle has taken shelter in gastropod shells.
- The appendages show claw which is used to capture food, as well as form an operculum for the shell.The uropods become hooklike and cling onto the inner aspect of the shell
- Hermit crab carries a sedentary sea anemone to newer and fresh feeding sites there by providing it with better opportunities of food, shelter and dispersal.
- The hermit crab recognises sea anemone chiefly by touch. To detach sea anemone from its original habitat to the shell, it massages the body of sea anemone with its claws. If the sea anemone is lost, the crab seeks a new one. Also when shiftng to a larger shell because of the growth, the crab detaches anemone from the old shell and fixes it onto the new one.
- Under dangerous circumstances, hermit crab withdraws itself ino the shell. In addition to this; it also gets protection from sea anemones due to the presence of batteries of nematocysts on its tentacles. The nematocysts inject poison into the predators. The anemone receives pieces of food dropped by the crab.
- This association between sea anemone and hermit crab has no metabolic dependency. There is mutual benefit, but at the same time the associaton is not obligatory.



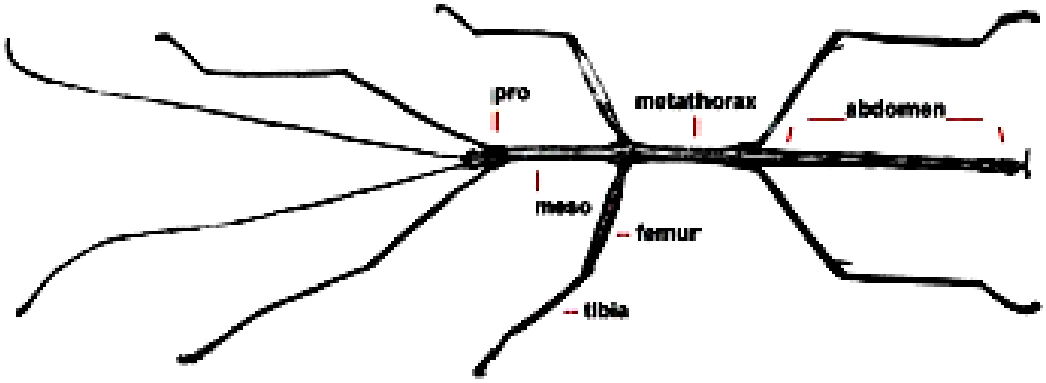
<u>HERMIT CRAB (*Eupagurus*) WITH SEA ANEMONE</u> *(Adamsia*) - FACULTATIVE MUTUALISM

IDENTIFICATION: <u>STICK INSECT</u> – MIMICRY

COMMENTS:

Mimicry refers to the resemblance of organisms with other organisms and with nonliving objects in the structure, color and behaviour to have advantage of escaping from the danger or to access the food. An organism that bears resemblance is called the MIMIC and the background to which a mimic resembles is called the MODEL.

- It is a classical example for protective and colouration mimicry.
- The stick insect is found in tropical forests.
- Body is slender and elongated resembling a twig or stick; hence the name.
- Body has three parts *viz;* head, thorax and abdomen. Head bears a pair of compound eyes and a pair of long filiform antennae.
- Prothorax is short, while meso and metathorax are elongated.
- Abdomen is elongated. Tegmina small or absent.
- Three pairs of simple, long, slender and stick like attenuated (weak with reduced functions) legs are present in the thoracic region.
- Male is small, active and with wings (pterous) but female is large, slugguish and without wings (apterous).
- The remarkable power of mimicry and camouflage is exemplified in the form of change of body colour which normally is in conformity with its surroundings.
- The adaptive abilities such as: 1) stick like appearance, 2) green or brown colouration, 3) becoming stiff, rigid and mimicing as if dead (Thanatosis) when disturbed confer extra protection to the species.



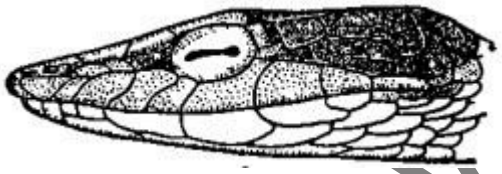
<u>STICK INSECT</u> – MIMICRY

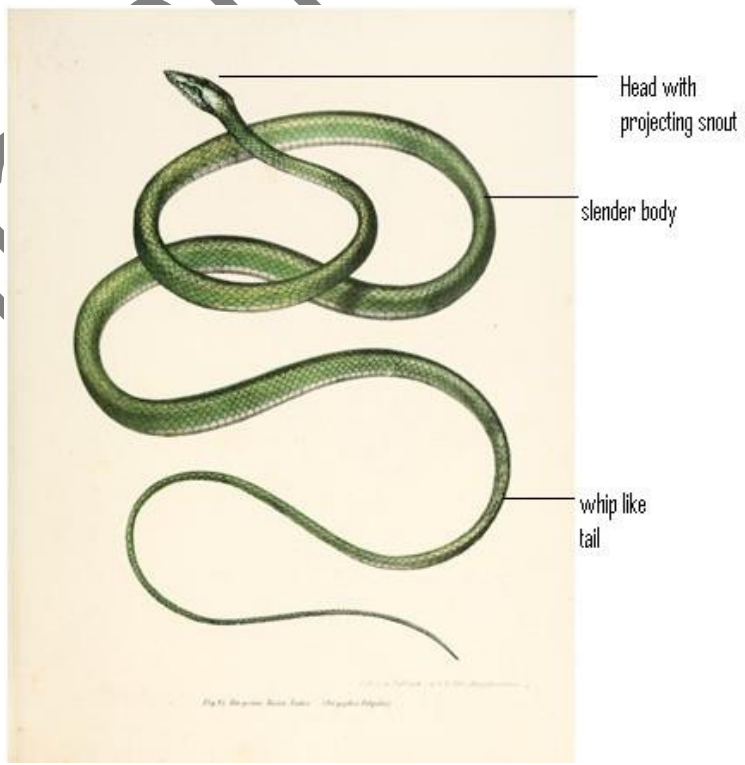
IDENTIFICATION: DRYOPHIS (Whip/Vine snake) – CAMOUFLAGE

COMMENTS

- The green vine snake is diurnal and mildly venomous. The body form is extremely slender with a long, pointed, projecting snout resembling the thin climber part of the background.
- Adult colouration varies from light brown to dull yellow-green and often a startling fluorescent green that allows mimicking the model.
- Adults may attain 1.8 m (6 feet) in total length, with a tail 0.6 m (2 feet) long. Very slender snake with long, thin whip-like tail. Large prominent eyes. Colour generally pale olive or bluish-grey, often with longitudinal stripes along front-third of body. Belly grayish-green, often yellowish under tail. Distinctive face markings. Obvious pale cream or yellow rim around eye, with dark comma-shaped mark curving back below eye.
- Pupil is horizontal, Vision is good. Posterior teeth fan like. Maxillary teeth are grooved.
- Although non poisonous its saliva is weakly piosnous which can kill small animals.
- The reptile normally feeds on frogs and lizards using its binocular vision to hunt. They are slow moving, relying on camouflaging as a vine in foliage. The snake expands its body when disturbed to show a black and white scale marking. Also, they may open their mouth in threat display and point their head in the direction of the perceived threat.
- The tail is thin, elongated, and prehensile and whip like.
- Its viviparous giving birth to young that grow within the body of the mother, enclosed within the egg membrane.

Eye showing horizontal pupil



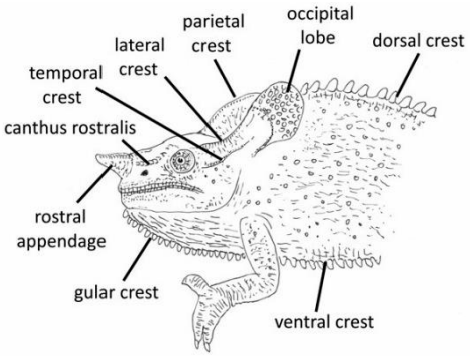


DRYOPHIS – CAMOUFLAGE

IDENTIFICATION: <u>CHAMELEON</u> – CAMOUFLAGE

COMMENTS

- It is arboreal insectivorous reptile. Adapted fpr climbing and visual hunting. They live in warm habitats.
- Body is covered with scales. Skin is granulated and form tubercles.
- Body is divided into head, neck, trunk and tail. Body and head are laterally compressed.
- Head has wide mouth, large eyes, small nostrils and back wardly directed hood or helmet.
- Some chameleons have a crest of small spikes extending along the spine from the proximal part of the tail to the neck; both the extent and size of the spikes varies between species and individuals. These spikes help break up the definitive outline of the chameleon, which aids it when trying to blend into a background.
- Eyes are large covered with thick glandular lids with small opening for pupil. They work independently while catching insects with monocular vision and are also telescopic.
- Tounge is spoon shaped, extremely protrusible and covered with a sticky secretion used to catch insects; located some distance away.
- Limbs are relatively large and very slender, pentadactyl.
- The digits of each limb are fused into two groups of three and two digits – Zygodactylus feet, which are used in grasping twigs. These specialized feet allow chameleons to grip tightly onto narrow or rough branches. Furthermore, each toe is equipped with a sharp claw to afford a grip on surfaces such as bark when climbing.
- Tail is long and prehensile. It has horny claws as scansorial adaptations.
- The eye balls protrude slightly from eye orbits when approached by enemies.
- It has the power of changing its body colour by the dermal chromatophores according to the change of light intensity or surrounding environment.
- Chromatophores are arranged in layers under the skin. Outer layer has xanthophores bearing yellow pigments and erythrocytes bearing red pigments. Below that are two reflecting layers having cells with guanine crystals. Chameleons change color by changing the space between the guanine crystals, which changes the wavelength of light reflected off the crystals and thus changes the color of the skin. One reflects white light and the other blue light. Fourth one has melanophores with melanin pigments that appear dark brown in color.



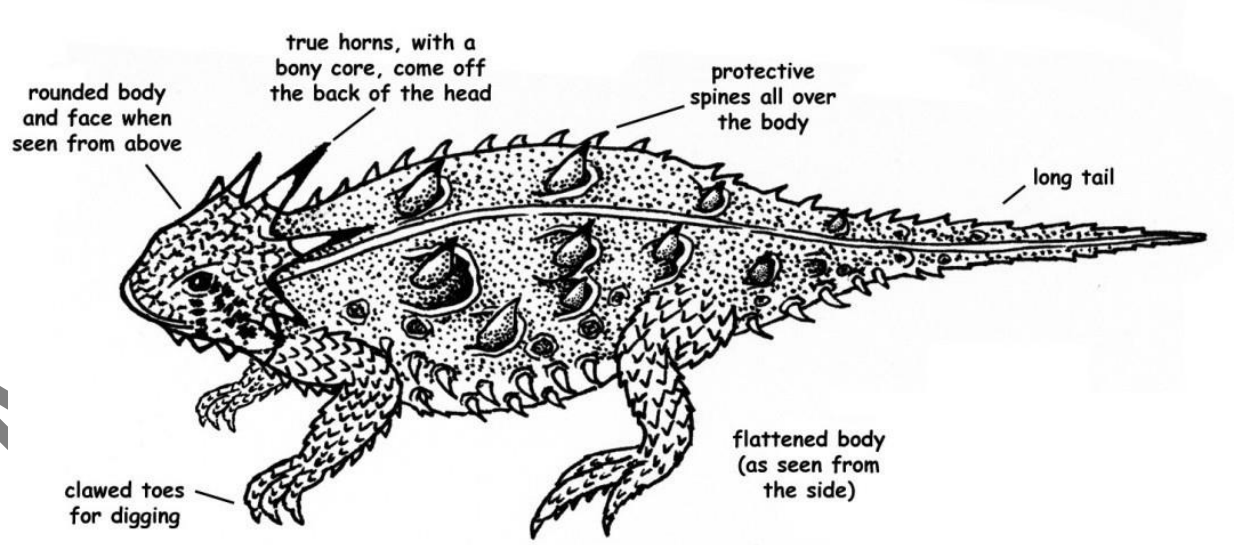
<u>CHAMELEON</u> – CAMOUFLAGE

IDENTIFICATION: <u>PHRYNOSOMA</u> (HORNED TOAD) - DESERT FORM ADAPTATIONS:

COMMENTS

Desert animals will have to face conditions like scarcity of water, extremes of temperature, abundance of sand and lack of cover. Thus their adaptations are to conserve water, defense against temperature, sand and enemies.

- It is nocturnal and lives under the shade of sparse vegetation or it lives in burrow during day to adopt for temperature extremes.
- Skin is dry, thick to reduce evaporation rate. In few species, the skin abosrbs water from moist sand like a blotting paper. They depend on metabolic water.
- Body is broad, flat, spiny and slender normally growing to a length of 12 to 13 cms. Limbs are long with broad feet, ending with clawed digits for fast running.
- Triangular head with blunt snout and row of horns. One post-orbital, three temporal and one occipital. The margin of the lower jaw projects as ridges and are protected by small spines. Upper side of the body is covered with large and strongly keeled scales.
- The spines on its back and sides are made from modified reptile scales which prevent the water loss through the skin; whereas the horns on the heads are true horns (have a bony core).
- The dorsal surface of the body is a blend of yellow, brown, grey and black colours and is covered by large and small strongly keeled scales. Small regular scales cover the ventral surface.
- Short neck with folded skin ventrally. Presence of distinct mid dorsal streak. Short and spiny tail. Fleshy, protrusible tongue. Nostrils have valves to prevent the entry of sand particles. Eyelids are complete.



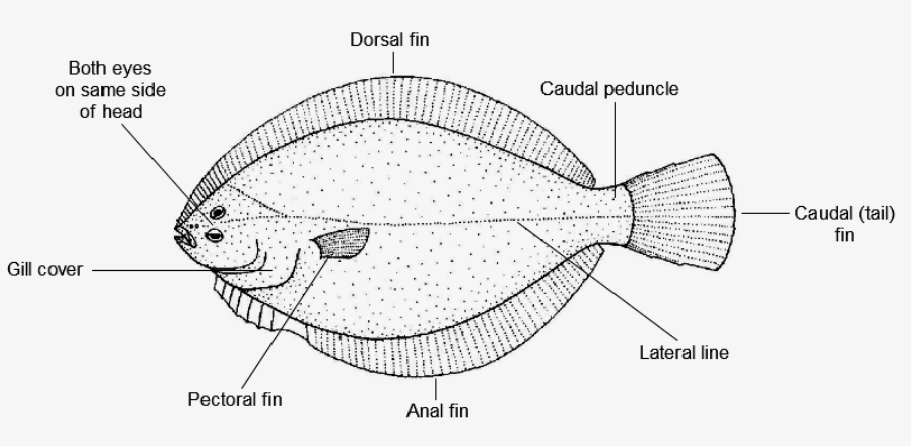
<u>PHRYNOSOMA</u> - DESERT FORM ADAPTATIONS

- To avoid predation, their coloration generally serves as camouflage. When threatened, their first defense is to remain still to avoid detection. If approached too closely, they generally run in short bursts and stop abruptly to confuse the predator's visual acuity.
- They puff up their bodies to cause them to appear more horned and larger, so that they are more difficult to swallow.
- They are also able to squirt stream of blood from the corners of the eyes for a distance of up to 5 feet. They do this by restricting the blood flow leaving the head, thereby increasing blood pressure and rupturing tiny vessels around the eyelids. This not only confuses predators, but also the blood tastes foul.
- To avoid being picked up by the head or neck, a horned lizard elevates its head and orients its cranial horns straight up, or back. If a predator tries to take it by the body, the lizard drives that side of its body down into the ground so the predator cannot easily get its lower jaw underneath.

<u>IDENTIFICATION</u> : PLEURONECTES (flat fish) - DEEP SEA FORM.

COMMENTS

- Deep sea has conditions like dark (Aphotic), cold, and lack of vegetation.
- Dorso ventrally flattened body with strong musculature on dorsal surface, helps in offering resistance to the high water pressure at the benthic region of the occean. Hence, this animal is included under benthic fauna.
- The surface of the fish facing away from the sea floor is pigmented; often serving to camouflage. The side of the body without the eyes, facing the seabed, is usually colourless or very pale. Flat fishes rely on their camouflage to avoid predators.
- Both the eyes are located on the dorsal side owing to asymmetry. The presence of protrusible eyes is an adaptation to benthic habitat. The vision is poor.
- Narrow mouth with protruded lower jaw.
- The skin is covered by IMBRICATE SCALES. The gills slits are covered by an operculum.
- Reduced pectoral and pelvic fins. The pelvic fins are placed anterior to the pectoral fins.
- Dorsal fin is extended onto the head. The dorsal and ventral fins extend along the entire length of the body and are continuous with the caudal fin (Synapturic condition).
- It lies partly buried in the sand at the floor of the ocean with its left side facing downwards.

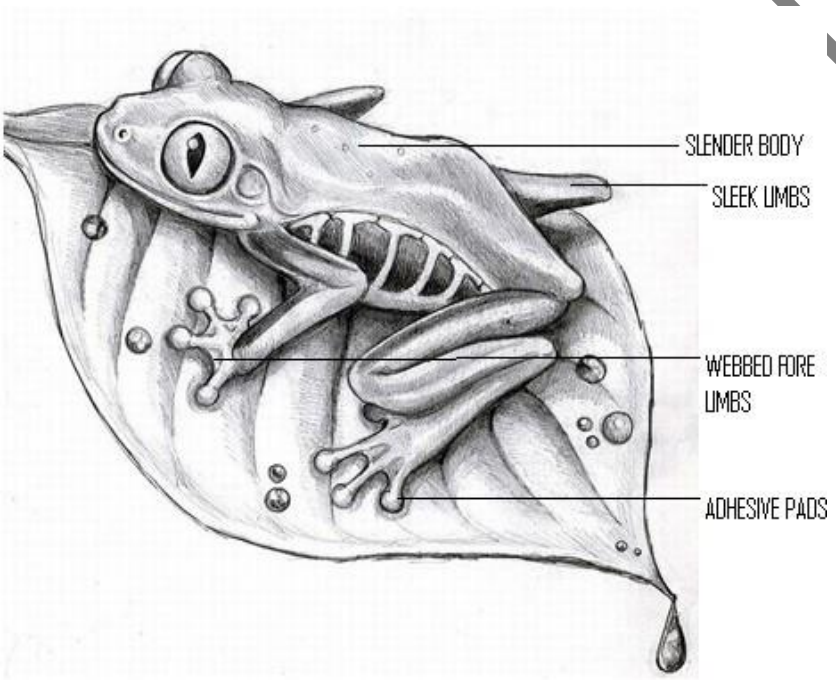


PLEURONECTES - DEEP SEA FORM

DENTIFICATION: <u>HYLA</u> (Tree frog) - ARBOREAL FORM.

COMMENTS

- It lives on the branches of the tree in damp rainy forests, except in India and Africa.
- Body is small and slender (measures 2.5 to 7.5cms); an adaptation for gliding and climbing purposes. Body has head and trunk. The head bears a pair of eyes, a pair of tympana (tympani), a pair of nostrils and a wide terminal mouth. The upper jaw bears teeth.
- Vocal sacs are well developed and produce loud voice.
- The skin is smooth on the dorsal surface. However, ventral surface bears papillae to enable the animal to have a firm grip while climbing the tree.
- Two pairs of limbs, the fingers and toes have glandular adhesive pads or discs that help in clinging onto the leaves and branches of the trees.The pads are slimy with mucous and bear grooves and ridges on the lower surface. The webbed digits assist in gliding.
- Between the last two phalanges of each digit, there is an INTERCALARY CARTILAGE, that helps in suitable accomodation of the adhesive pads while climbing trees.
- Exhibits COLORATION MIMICRY (CAMOUFLAGY). The animal develops green or brown body coloration to mimc the color of the leaves or branches respectively.



<u>HYLA</u> - ARBOREAL FORM