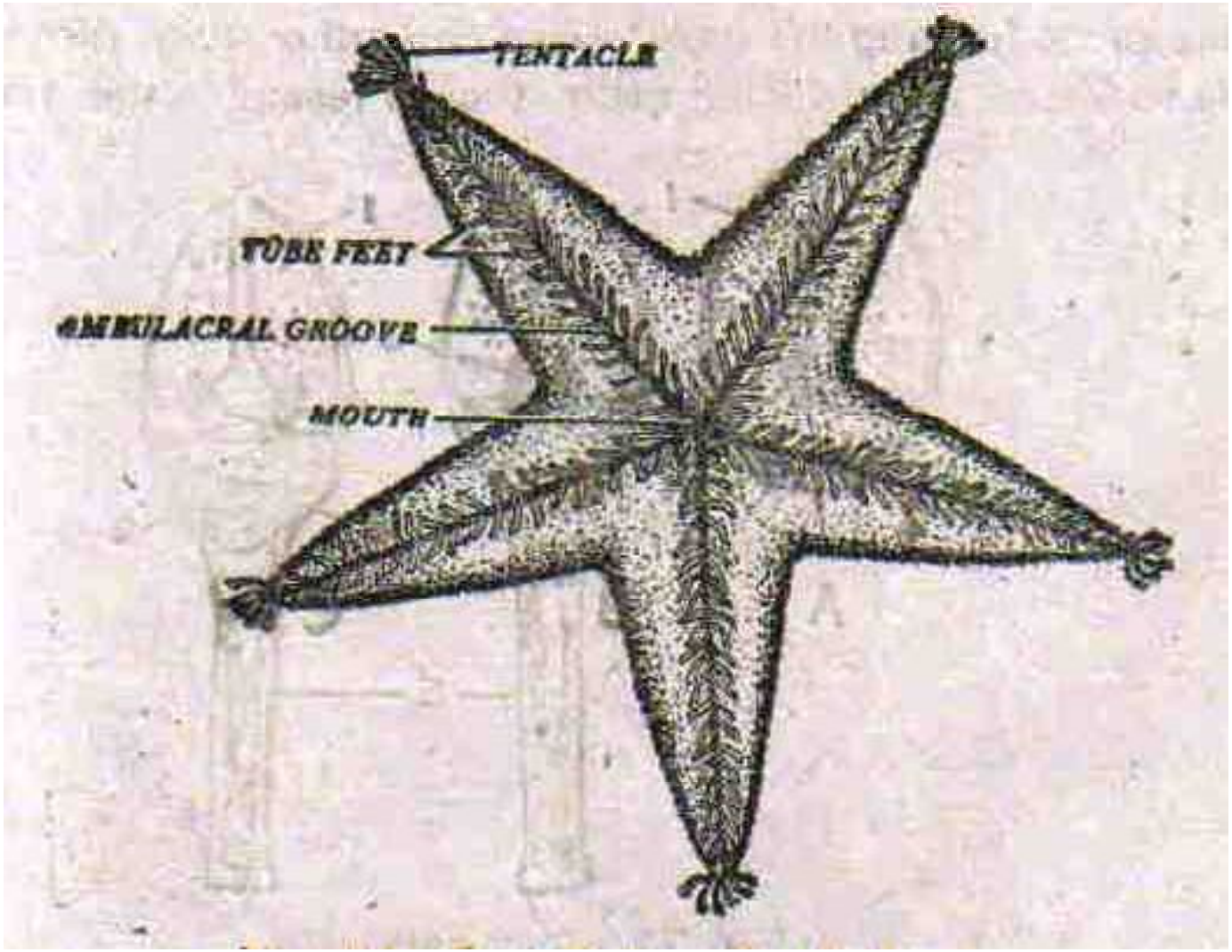
# *ASTERIAS RUBENS*

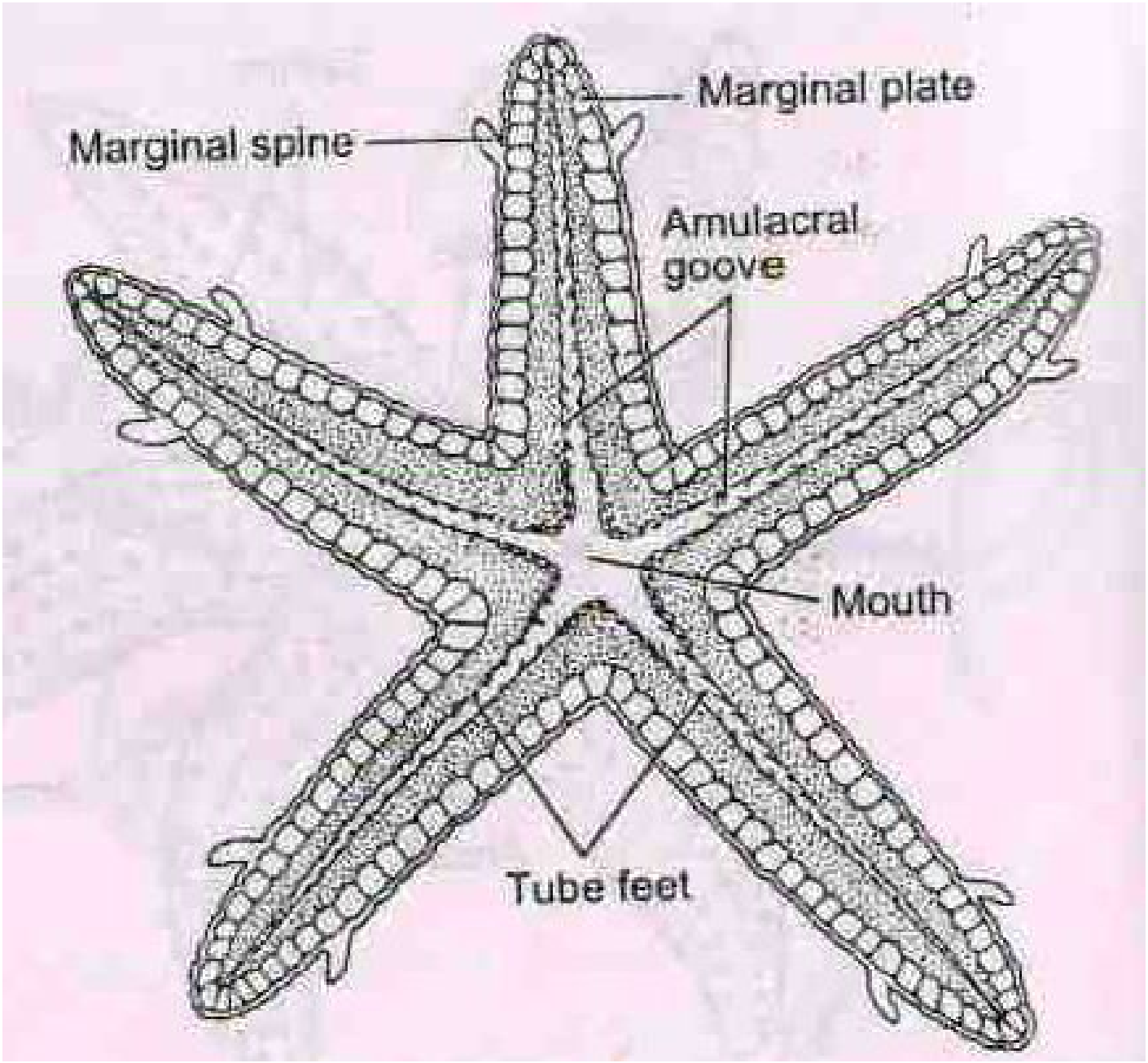
# External features

- Body is **star-shaped** with central disc and 5 radiating arms
- **Oro-aborally** flattened
- **Oral / actinal** side is facing downwards towards the substratum
- **Aboral / abactinal** side is facing up
- Region between two arms is called **interradius**
- **Bivium** are the two arms between which lies the madreporite; **trivium** are the other three arms
- End of each arm has **tentacles** and **eyespot**


TENTACLE
TUBE FEET
AMBULACRAL GROOVE
MOUTH

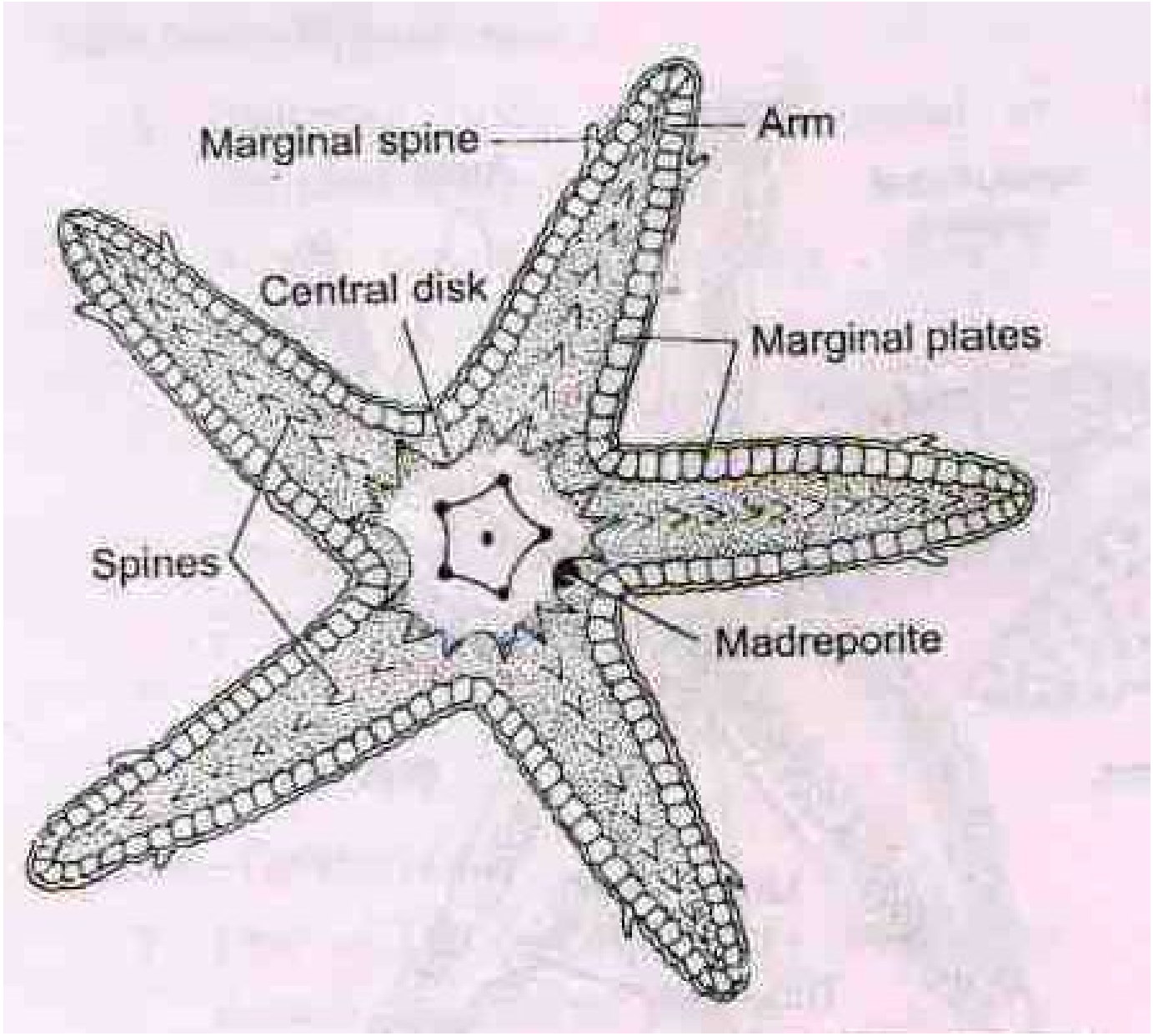
# Oral side

- **Mouth** is situated at the centre
- Mouth is surrounded by a soft membrane called **peristome**
- Long grooves called **ambulacral grooves** starts from mouth and ends in the arms
- On either side of the ambulacral groove, thin-walled tubular structures called **tube feet** is present


Marginal plate
Marginal spine
Amulacral
goove
Mouth
Tube feet

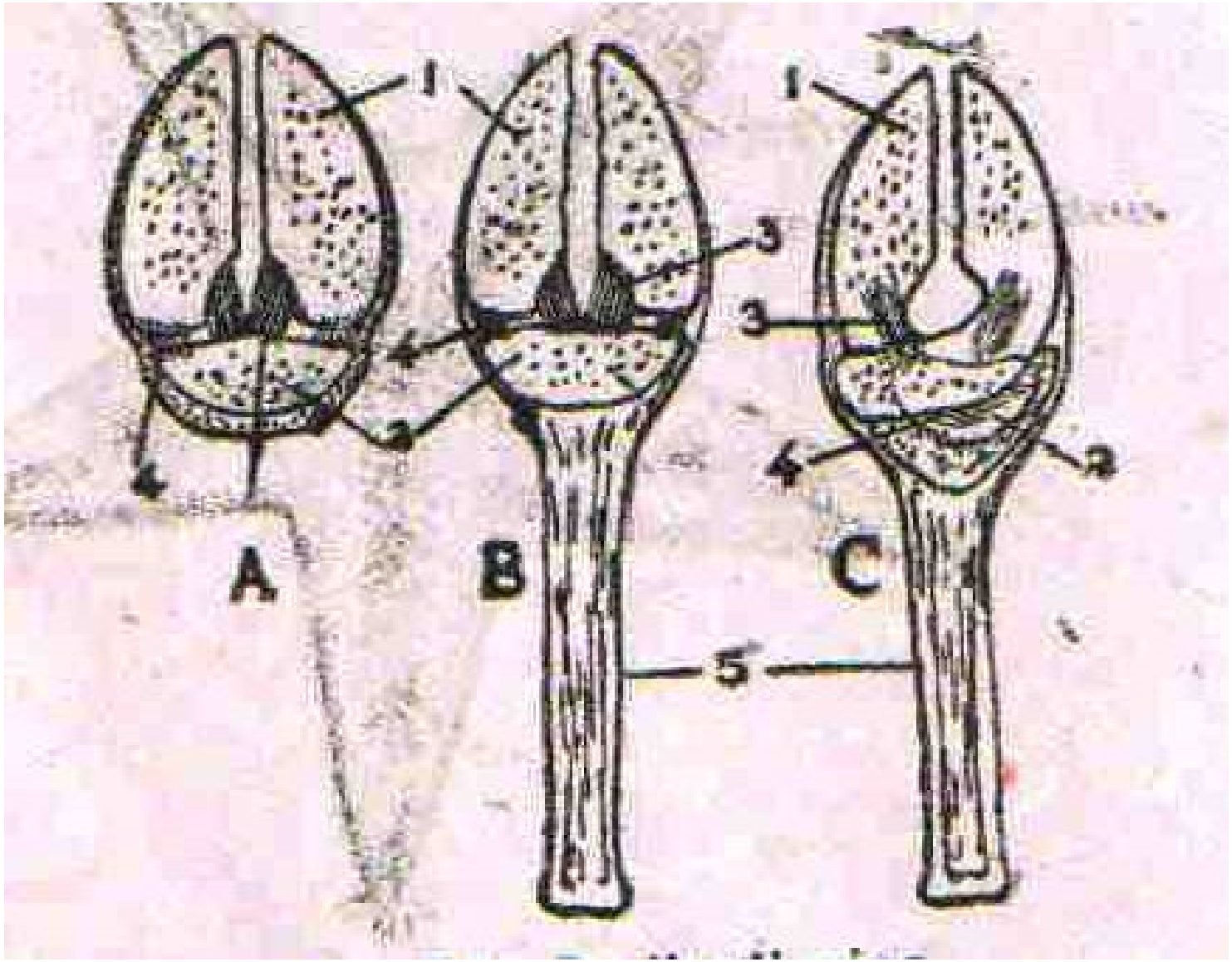
# Aboral side

- **Anus** is present
- **Madreporite** is a sieve-like plate found between the bivium
- **Spines** are present.  They are seen protruding out of the thin layer of skin


Marginal spine
Arm
Central disk
Marginal plates
Spines
Madreporite

# Pedicellaria

- Pedicillaria are minute **forceps-like structure** found between the spines. Hence are called **forcipulate pedicellaria**
- Formed of 3 pieces: 1 **basal piece** and 2 pieces of **valves or jaws**
- They are supported by **calcareous** material
- Valves operate by a pair of **abductor muscles (for opening)** and 2 pairs of **adductor muscles (for closing)**
- 2 types of pedicillariae: (1) **sessile** – have no stalk and (2) **stalked / pedunculate** – have basal stalk


1
1
3
3
4
4
2
2
A
B
C
5

# Functions of pedicellaria

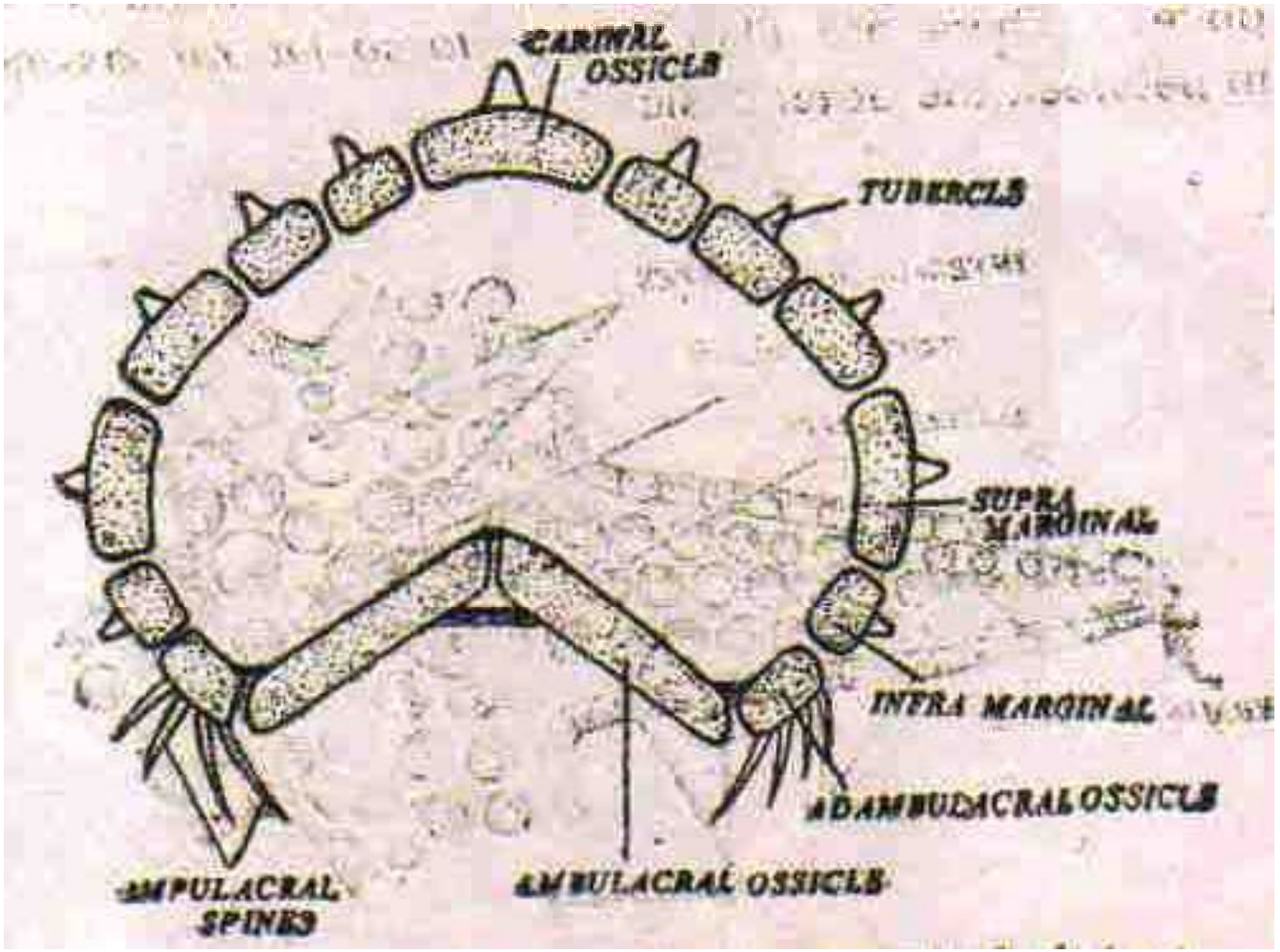
- **Prehensile** – used for grasping small objects
- Organs of **offense** and **defence**
- Help to **clean** the surface of the body of debris, sand grains, etc
- Used to **capture** small prey
- **Protect** the dermal papulae

# Skeleton

- Endoskeleton is formed of calcareous plates called **ossicles**
- Classified into (1) **ambulacral** skeleton and (2) **ambital** skeleton

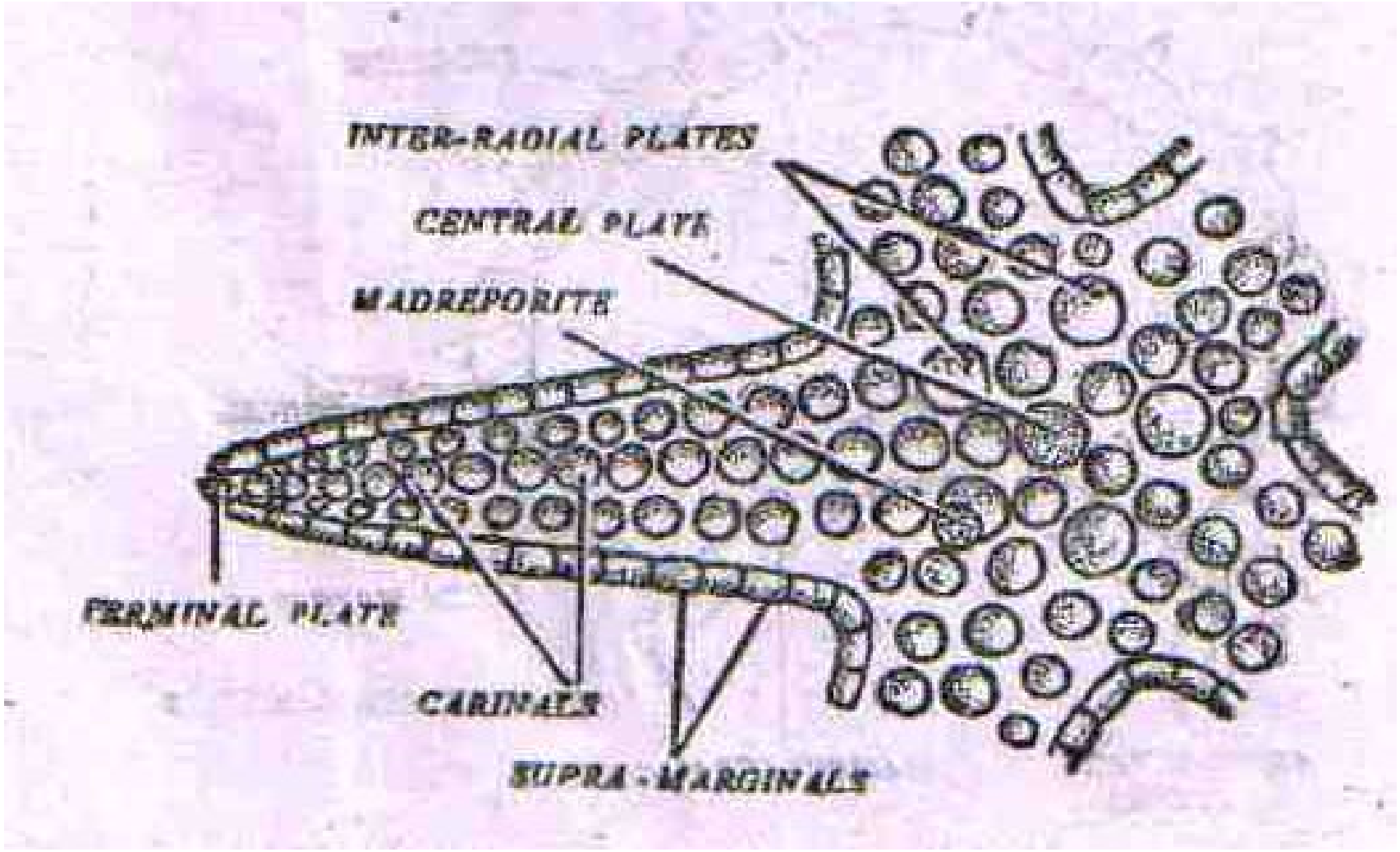
# (1) Ambulacral skeleton

- Ossicles that are arranged on either side of **ambulacral groove**
- **Ambulacral ossicles** are rod-like ossicles arranged in the form of inverted "v". Tube feet pass between them
- **Adambulacral ossicles** are found on the outer end of ambulacral ossicles. They are provided with spines that protect tube feet
- **Supramarginal** and **inframarginal ossicles** are found on the margins of each arm
- **Skeletal ring** or mouth frame is formed around the mouth


CARINAL OSSICLS
TUBERCLS
SUPRA MARGINAL
INFRA MARGINAL
ADAMBULACRAL OSSICLS
AMBULACRAL OSSICLS
AMPULACRAL SPINES

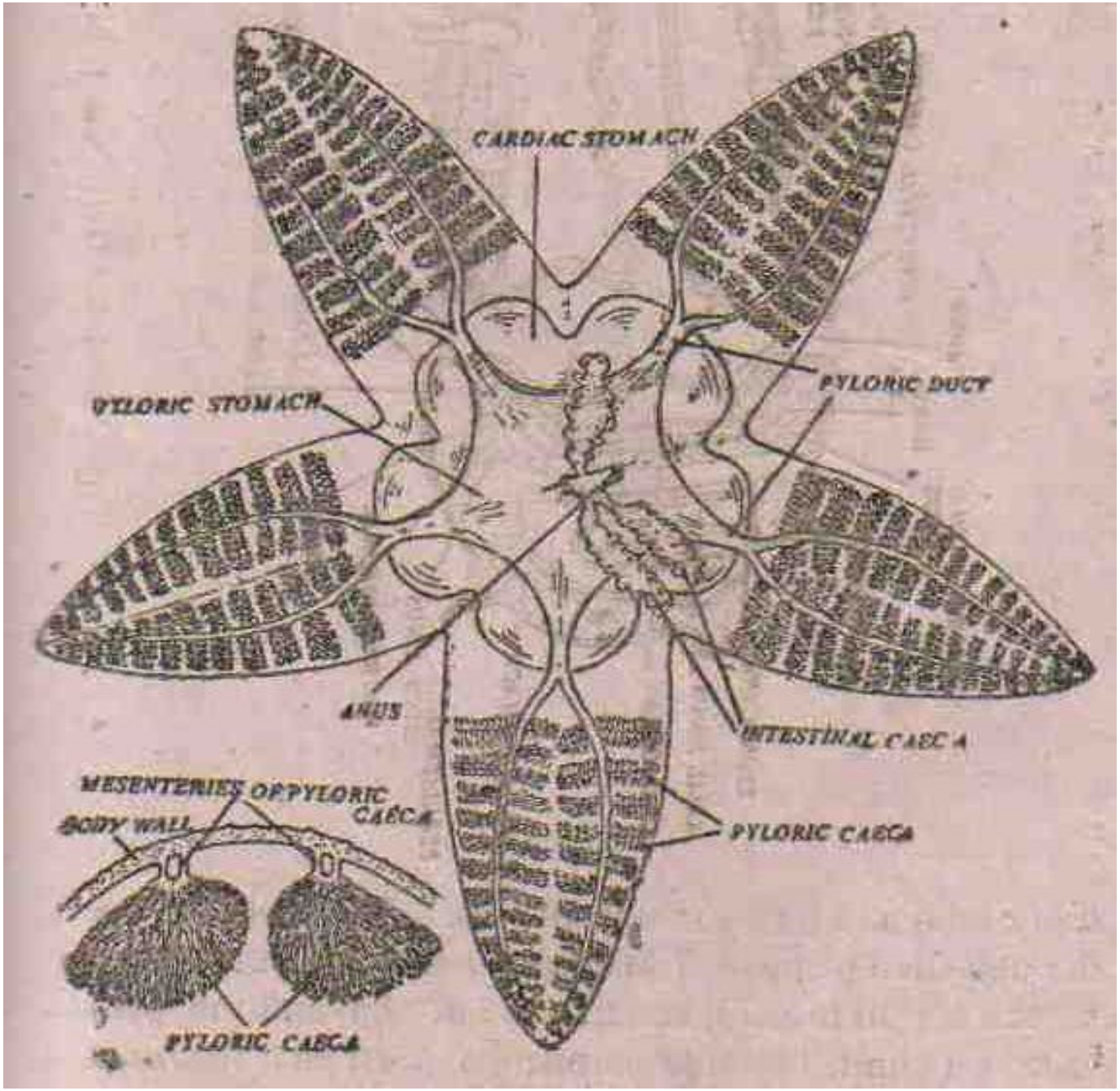
# (2) Ambital skeleton

- Smaller **plate-like** ossicles found on the **upper side**
- **Central plate** is single and found at the centre
- **Five radials** are radial in position found at the base of each arm
- **Five basals** are interradial in position. Madreporite is fused with one of the basal plates
- **Carinals** are found in the middle line of each arm
- **Terminal plate** is found at the end of each arm
- Many **dorso-lateral ossicles** lie inbetween the other ossicles


INTER-RADIAL PLATES
CENTRAL PLATE
MADREPORITE
TERMINAL PLATE
CARINALS
SUPRA-MARGINALS

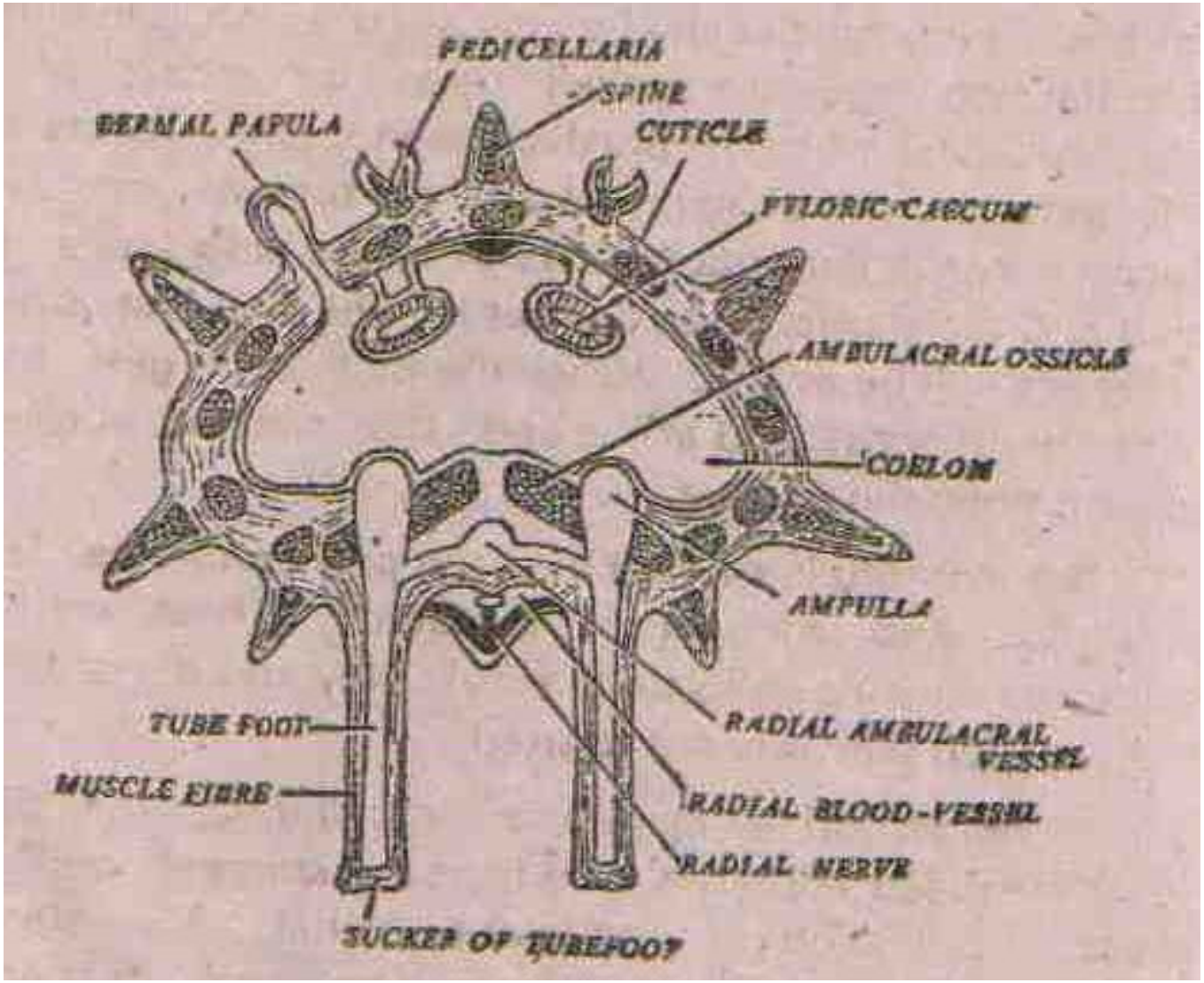
# Digestive system

- **Alimentary canal** and the **digestive glands**
- Alimentary canal is formed of mouth, oesophagus, stomach, intestine, rectum and anus
- **Mouth** is a circular opening found on the oral side
- **Stomach** is divided into 2 regions (1) **cardiac** – large chamber with 5 lobes and (2) **pyloric** – small, flattened and pentagonal chamber. Cardiac stomach is held in position by gastric filaments
- The digestive gland is **pyloric caeca.** There are **5 pairs** of pyloric caeca, one in each arm


CARDIAC STOMACH
PYLORIC STOMACH
PYLORIC DUCT
ANUS
INTESTINAL CAECA
MESENTERIES OF PYLORIC CAECA
BODY WALL
PYLORIC CAECA
PYLORIC CAECA

# Respiration

- Carried out by thousands of **dermal branchiae** or **papulae**
- They are simple, transparent, **evaginations** from the body wall and lined with **ciliated epithelium**
- **Exchange of gases** takes place along the thin wall
- **Tube feet** also serve for exchange of gases


PEDICELLARIA
SPINE
DERMAL PAPULA
CUTICLE
PYLORIC CAECUM
AMBULACRAL OSSICLE
COELOM
AMPULLA
TUBE FOOT
RADIAL AMBULACRAL VESSEL
MUSCLE FIBRE
RADIAL BLOOD-VESSEL
RADIAL NERVE
SUCKER OF TUBEFOOT

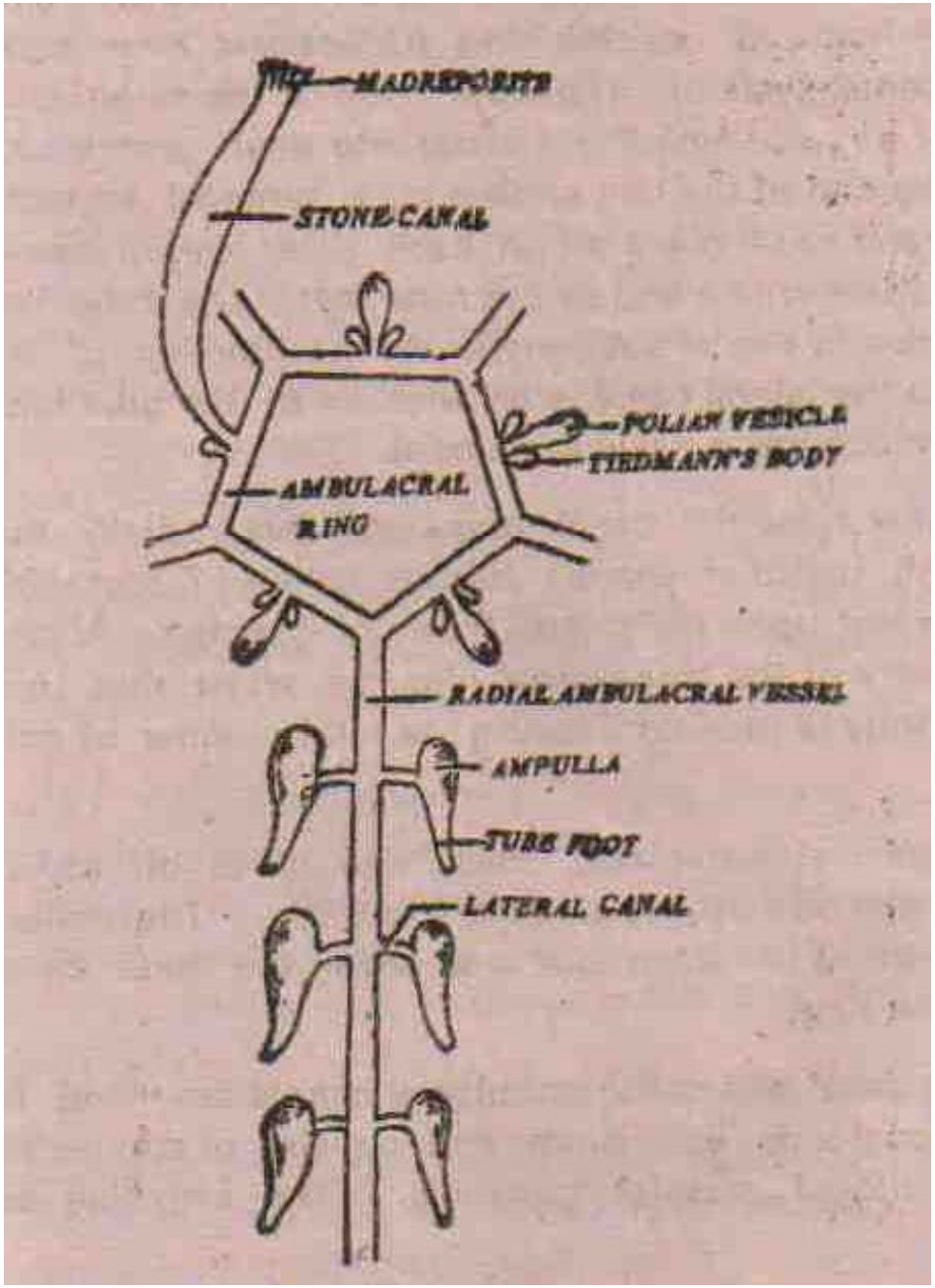
# Excretion

- Excretion is by **amoebocytes** found in the coelomic fluid

- They collect **nitrogenous waste** products (ammonia) from the coelom and expel out through the thin wall of **dermal papilla**

# Water vascular system

- Otherwise called **ambulacral system**
- Peculiar **only** to echinoderms
- It is a **system of canals** filled with fluid containing sea-water and certain corpuscles
- It is formed of madreporite, stone canal, ring canal, radial canals, Tiedmann's bodies, polian vesicles, lateral canals and tube feet

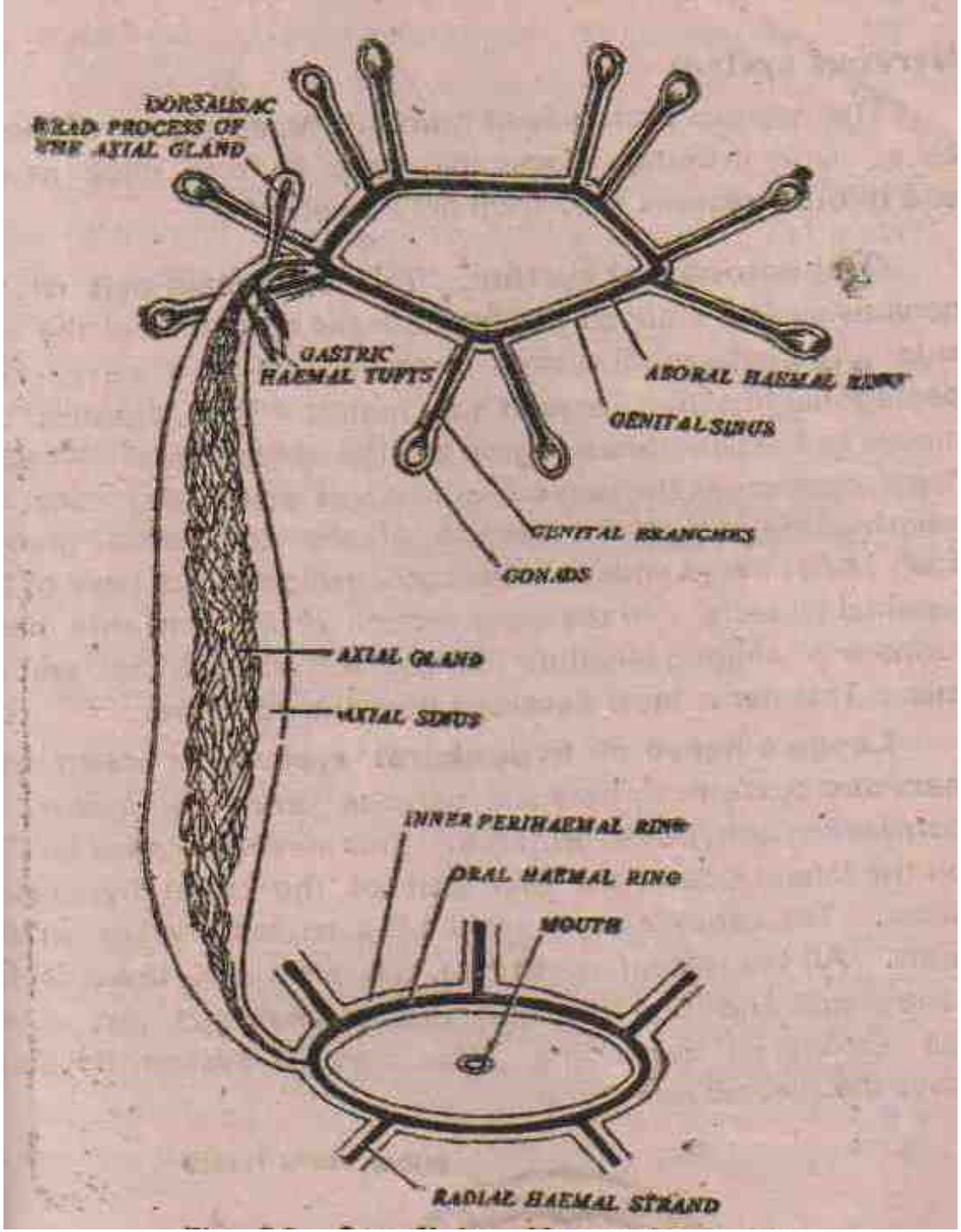

MADREPORITE
STONE CANAL
POLIAN VESICLE
TIEDMANN'S BODY
AMBULACRAL RING
RADIAL AMBULACRAL VESSEL
AMPULLA
TUBE FOOT
LATERAL CANAL

# Circulatory system

- Circulatory system is of **open** type
- It is formed of two systems (1) **perihaemal** system and (2) **haemal** system

# Haemal system

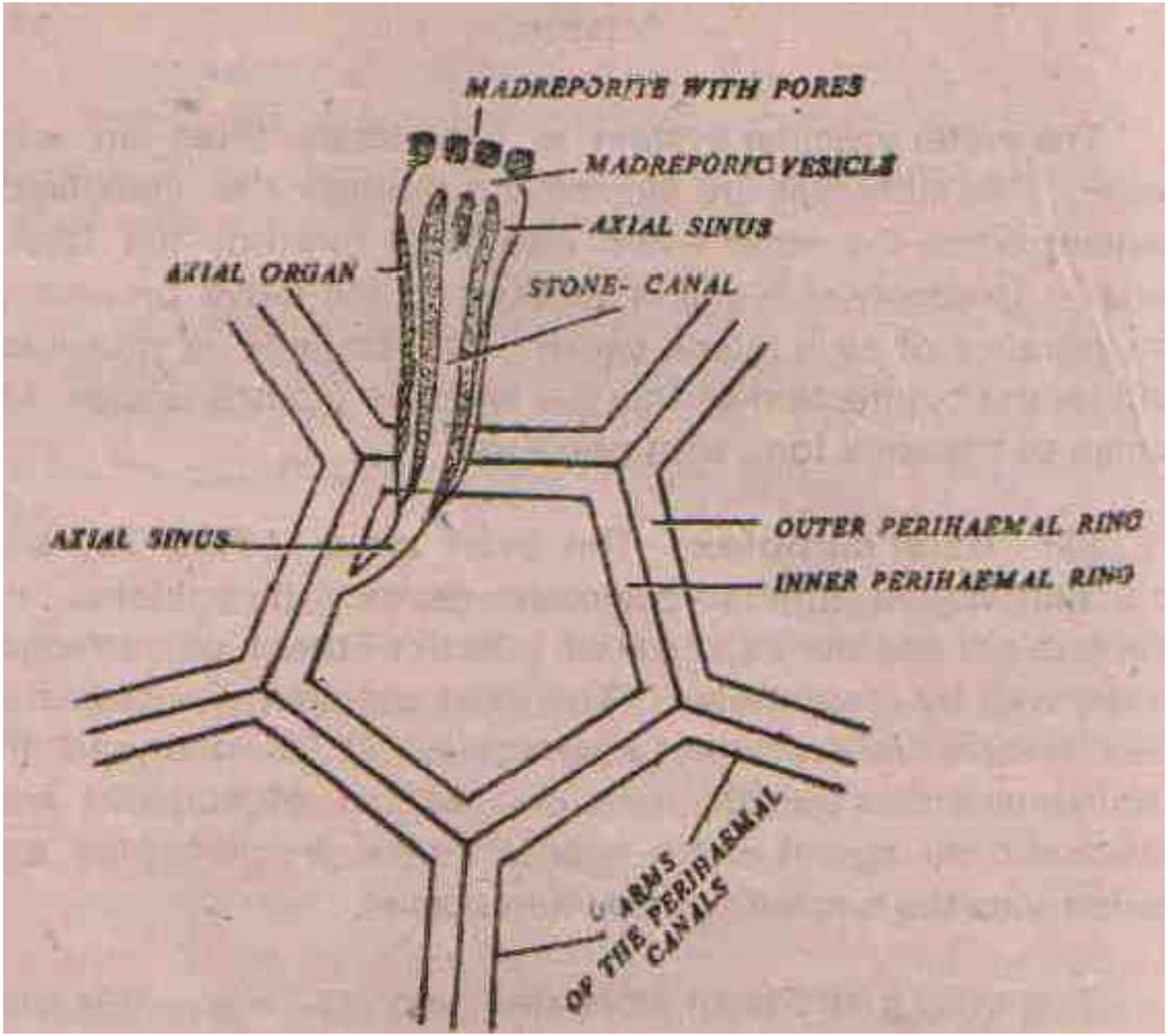
- It is the **blood lacunar system** and filled with coelomic fluid
- **Oral haemal ring** – lies around the mouth and gives of radial haemal strands and lateral branches
- **Aboral haemal ring** – lies inside aboral perihaemal ring sinus and gives off genital haemal strands
- **Axial gland** – Referred to as heart, ovoid gland, dorsal brown gland, etc
- **Functions of haemal system**
  - Distributes food materials
  - Axial gland maintains flow of blood by its contractile activity
  - Produce sex cells


DORSAL SAC
RADIAL PROCESS OF THE AXIAL GLAND
GASTRIC HAEMAL TUFTS
ABORAL HAEMAL RING
GENITAL SINUS
GENITAL BRANCHES
GONADS
AXIAL GLAND
AXIAL SINUS
INNER PERIHAEMAL RING
ORAL HAEMAL RING
MOUTH
RADIAL HAEMAL STRAND

# Perihaemal system

- It is a system of **channels** formed of **spaces**
- It encloses water-vascular system and haemal system
- It is formed of aboral ring sinus, gneital sinus, oral ring sinus, axial sinus, radial perihaemal sinus, lateral channels, marginal sinus and peribranchial sinus

- **Aboral ring sinus** – pentagonal tube lying around intestine on the aboral side
- **Genital sinus** – pair of tubes produced from aboral ring sinus enclosing the gonads
- **Oral ring sinus** – circular channel lying around the mouth divided by haemal strand to produce outer and inner oral ring sinus
- **Axial sinus** – vertical tubular sinus enclosing axial gland and stone canal
- **Radial perihaemal sinus** – channel lying in the arm
- **Lateral channel** – arising from radial perihaemal sinus and supplying tube feet
- **Marginal sinus** – two in number and lying on the margins
- **Peribranchial sinus** – located around the base of dermal branchiae


MADREPORITE WITH PORES
MADREPORIC VESICLE
AXIAL SINUS
AXIAL ORGAN
STONE- CANAL
AXIAL SINUS
OUTER PERIHAEMAL RING
INNER PERIHAEMAL RING
ARMS OF THE PERIHAEMAL CANALS

# Nervous system

- Is of **primitive** type
- Formed of **nerve cells** and in certain places unite to form **nerve-strands**
- **Four types**
  - Ectoneural nervous system or superficial nervous system
  - Deep oral nervous system or hyponeural system or Lange's nerve
  - Aboral or coelomic nervous system
  - Entoneural nervous system

- **Ectoneural nervous system** – beneath the epidermis
- **Deep oral nervous system** – in the oral region
- **Aboral nervous system** – in the aboral region
- **Entoneural nervous system** – outer margins of ambulacral grooves

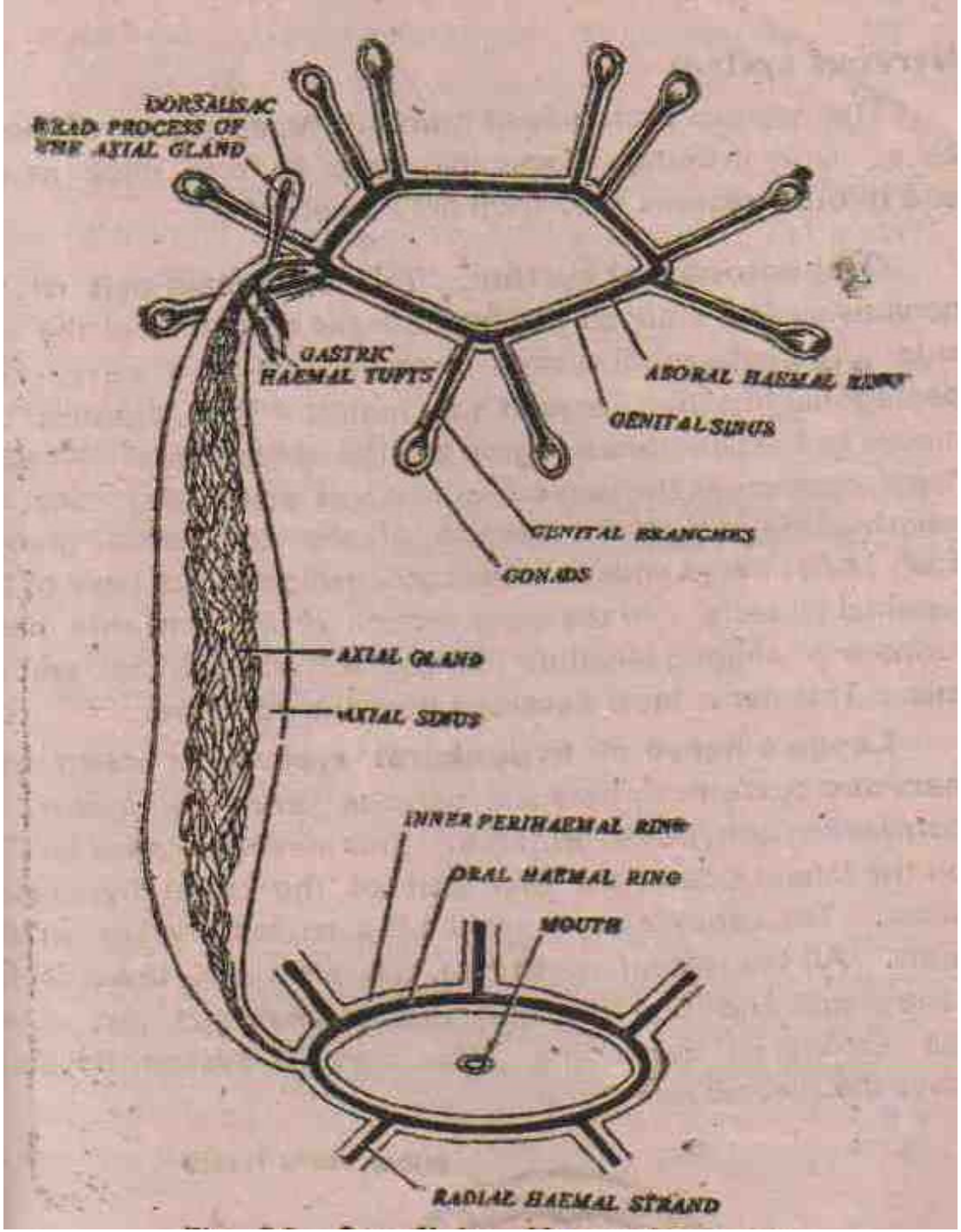
# Sensory organs

- **Neurosensory cells** – spindle shaped cells distributed throughout the epidermis; abundant in tentacles, tube feet and base of pedicellaria; tactile or olfactory in function

- **Eyes** – has five eyes at the end of each arm; made of ocelli, lens, cuticle, pigment cells, retinal cells and nerve fibre; cannot form image but detects changes in light intensity

# Reproductive system

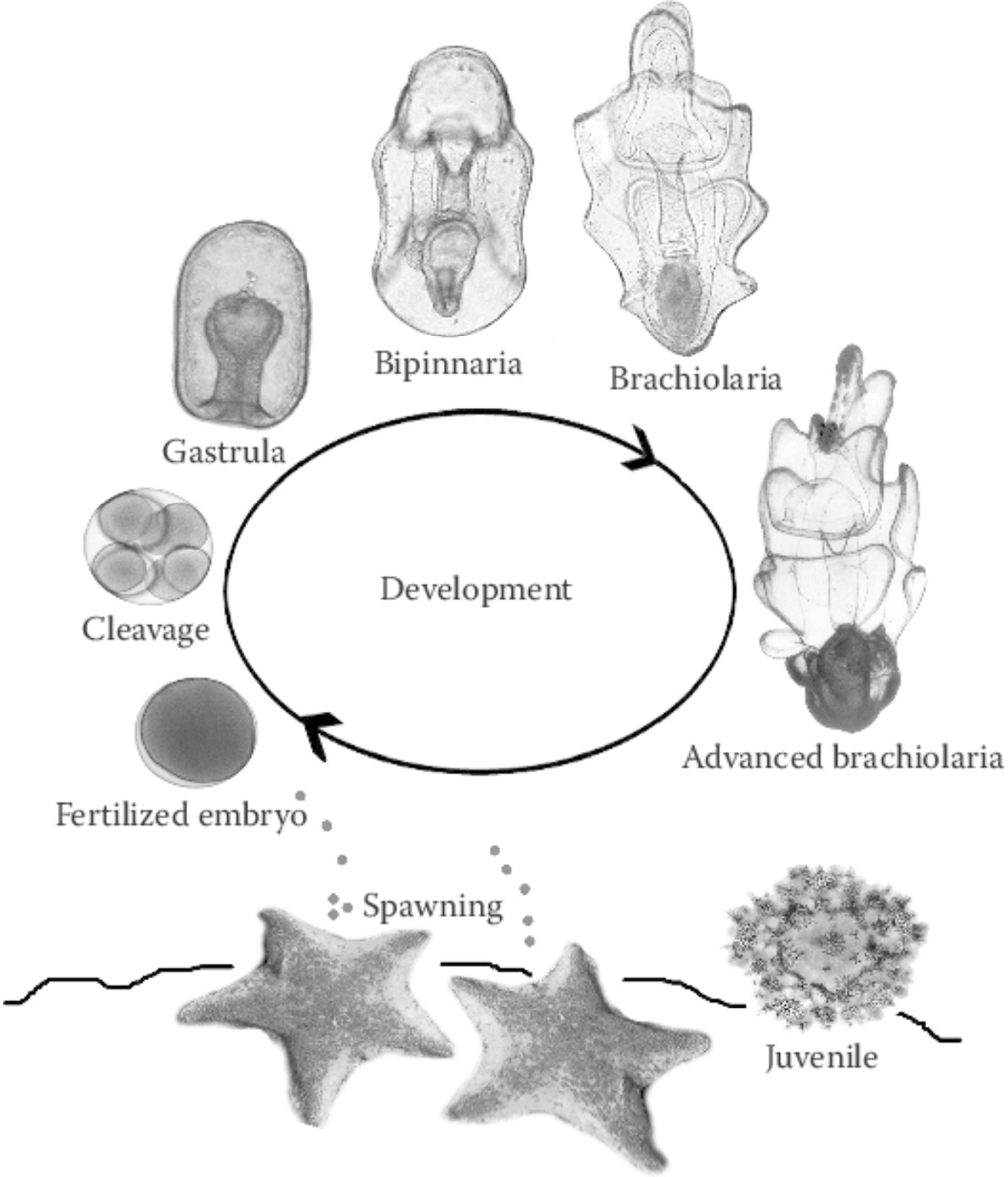
- Starfish is **unisexual** – sexes are separate
- No sexual dimorphism
- Has **five pairs of gonads** enclosed in genital sinus
- From each gonad arises **gonoduct** which open through **gonopore** to the outside
- Gametes originate in **axial gland** and later migrate to gonads


DORSAL SAC
RADIAL PROCESS OF THE AXIAL GLAND
GASTRIC HAEMAL TUFTS
ABORAL HAEMAL RING
GENITAL SINUS
GENITAL BRANCHES
GONADS
AXIAL GLAND
AXIAL SINUS
INNER PERIHAEMAL RING
ORAL HAEMAL RING
MOUTH
RADIAL HAEMAL STRAND

# Life cycle

- Development is **indirect** involving larval forms

- **Fertilization** is external. **Zygote** is formed
- **Cleavage** is holoblastic and equal
- **Blastula** is spherical, ciliated and freely swims in water
- Invaginates to form **gastrula**
- Develops into **bipinnaria** and **brachiolaria larva**
- **Metamorphosis** leads to adult starfish
- Starfish exhibits **autotomy** and **regeneration**


Bipinnaria
Brachiolaria
Gastrula
Development
Cleavage
Advanced brachiolaria
Fertilized embryo
Spawning
Juvenile

# END