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WORKSHEET 20

School: **Ba Sangam College**

Subject: **Biology**

Year: **13**

Name: _____

Strand	13.3 Biodiversity Change and Sustainability
Sub strand	B13.3.2.6 Kingdom Animalia
Content Learning Outcome	Describe the characteristics that classify organisms in this kingdom to different categories; and explore the increasing complexities of the different groups from simple organisms to complex chordates

PHYLUM ECHINODERMATA

Main features of the phylum:

- ◆ Examples include sea stars, brittle stars, sand dollars and sea cucumbers.
- ◆ Are marine, triploblastic unsegmented.
- ◆ Are coelomates and deuterostomes.
- ◆ The anus is on the upper surface (aboral surface) and the mouth on the lower surface (oral surface).
- ◆ Pedicellariae are small jaw-like structures on the outer surface of the starfish. They have a protective function and also help to trap small prey. Echinoderms have 3 unique features:
- Adults are radially symmetrical while larvae are bilaterally symmetrical.
- Have internal calcareous skeleton which is made of calcium carbonate.
- Have tube feet

Echinoderm Skeleton

- Internal skeleton of calcium carbonate
- Presence of ossicle: small calcareous elements embedded in the dermis of the body wall of echinoderms which forms part of the endoskeleton and provide rigidity and protection Water Vascular System
- The water vascular system is a hydraulic system used by echinoderms for locomotion (through movement of tube feet), food and waste transportation, and respiration.

How the Water Vascular System works

- Along each arm of the starfish (lower surface) is a groove that bears rows of tube feet. These tube feet are operated by the WVS, a system of canals filled with fluid.
- Water enters the system through the sieve plate (or madreporite) on the upper surface of the starfish to a connecting canal that leads to the ring canal within the central disc.
- From the sieve plate, water passes into the ring canal within the central disc (ring)
- It then passes into the radial canals in the radiating arms

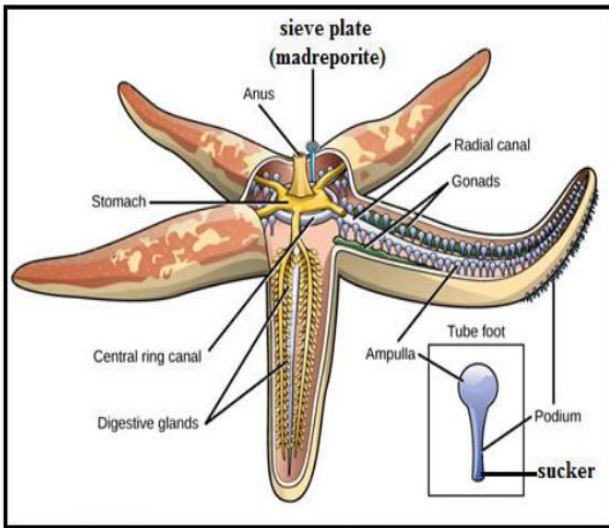
Flow of water in the Water Vascular System

Sieve plate → short connecting canal → ring canal → radial canals → tube feet

At the tube feet

- The tip of the foot bears a sucker, the other end bears an ampulla.
- A valve is at the joint where branch (arm) canal joins tube foot.
- When ampulla contracts, water is forced out of the sucker end of the tube foot, and the foot moves forward and attaches to substrate.
- The valve keeps water from flowing back in the canal.
- When foot muscles relax water flows into the ampulla, foot loosens and eases forward.
- Contraction and expansion of ampulla

corresponds to the extension and shortening of tube feet to achieve movement



Nervous System

- Echinoderms have a diffuse nervous system with no “brain”.
- Consists of nerve network that is connected to ganglionated nerve cords found around the body.

Significance of radial symmetry

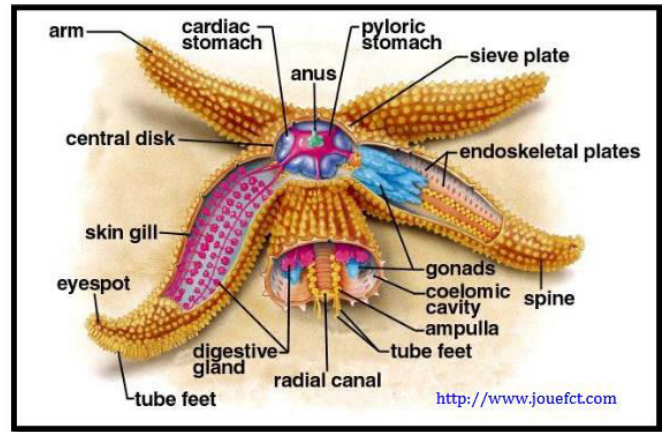
- Believed that bilateral symmetrical multicellular animals have evolved from radially symmetrical organisms.
- Radially symmetrical organisms have sac-like body, double layered body and this resembles embryonic gastrula of higher animals.
- Radially symmetry – adaptation for sedentary or sluggish way of life.
- Most undergo metamorphosis (from free swimming bilateral symmetrical larva to a bottom dwelling adult with radial symmetry).

Divisions of Echinodermata

Phylum Echinodermata is divided into 5 classes.

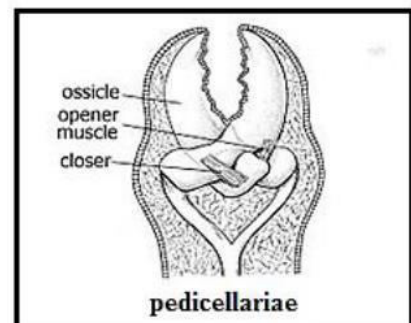
CLASS Asteroidea (star like)

- Some live in sandy or muddy substrates
- Typically have central disc and five arms
- Many species are brightly coloured



Body Plan

- Spines form calcium plates called ossicles.
- The oral surface of each arm has a single ambulacral groove
- Have a large coelom where all the main organs occur
- Pedicellariae: Specialized pinchers found on the aboral surface surrounds the spines.
- Feeding and digestion Mouth is in the centre of the lower surface of the disk, short oesophagus, broad stomach and short-intestine within the central disk. It uses to manipulate prey as follows:
 - The sea star attaches its suckers of its tube feet to both halves of the clam shell and pulls until the shell open a crack.
 - The sea star then turns the stomach inside through its mouth & inserts its stomach into the clam.
 - Enzymes secreted by the sea stars stomach digest the clam's soft part while they are still in the shell.



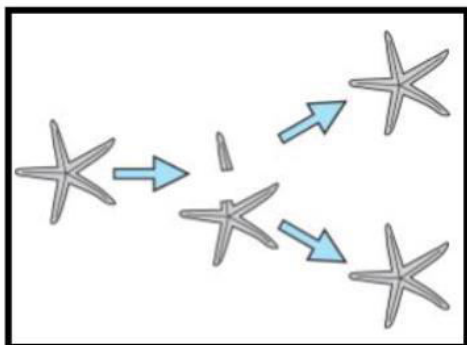
Reproduction

- **Sexual Reproduction** Fertilisation is external and occurs in water where eggs and sperms are released.
- - Fertilized egg develops into a **bipinnaria larva**.

After 2 months the larva settles to the bottom and undergoes metamorphosis

Asexual Reproduction (regeneration)

- Most species can regenerate from fragments that include the disk as follows.



Other Systems Fluid in the coelom bathes the organs.

- Nutrients and oxygen are exchanged within the fluid
- Gas exchange and waste excretion takes place through diffusion through thin walls of the tube feet and skin gills.
- Are ecologically important because they prey on oysters, clams and other organisms

CLASS Ophiuroidea (snake-like)

- Well-developed ossicles in the arms forming a system of articulating vertebrae
- The oral surface bears 5 pair of bursal sacs
- Is the largest, which live primarily on sea bottom beneath stone.
- Distinguished long narrow arms which allow them to move very quickly.
- Have a large stomach with no intestine or anus
- Are coral inhabitants
- Regenerate well; reproduces asexually by regeneration.

CLASS Echinoidea

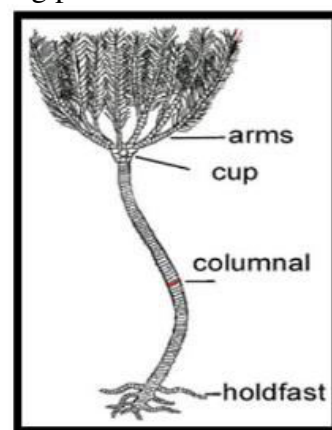
- Ossicles are joined to form a rigid test
- Two attributes: mobile spines, and hollow skeleton or test Sea urchin
- The internal organs are enclosed within a compact, rigid endoskeleton called a test.
- Use tube feet for locomotion, feed by scraping algae from hard surface.
- Have-barbs on long spines (protection from predators)
- Gas exchange is by highly branched gills or

modified tube feet.

- Ingestion and Digestion All are herbivores Feed on alga material so are mainly found in sunlit waters.
 - Food is chopped by 5 sharp pointed teeth (Aristotle's lantern)
 - The digestive system is long to deal with vegetable manner
 - The anus is located aborally.
- Reproduction
 - At spawning the entire coelom will fill with sperm or eggs.

CLASS Crinoidea (lily like) e.g Feather Star

- These are mainly filter feeders.
- Are sessile. Have long stalk attached to rocks or sea bottoms.
- The 5 arms branch out to form many more arms.
- 10 arms have podia (no ampullae) lining ciliated grooves feeding particles to the mouth.



CLASS Holothuroidea (Eg. Sea cucumbers)

- Are aimless, reside on sea bottom and have a soft body i.e. no large exoskeleton.
- They have no calcitic skeleton, except for spicules embedded in a leathery skin
- Most are immobile, and lie on the sea bed rolling back and forth with the swell. Some have limited mobility using their tube feet Tube feet present on ventral side.
- A fringe of tentacles surrounds the mouth which sweeps up sediment and water.
- Respiratory trees are often fed oxygen by the sea cucumber actually breathing through their anus. These respiratory trees are unique to sea cucumbers.

1. How can the endoskeleton of echinoderms be compared to similar structures among vertebrates, arthropods and molluscs?

2. What system allows echinoderms to move around and attach to certain substances?

3. What type of digestive system echinoderms contain?

4. What characteristic of echinoderm embryos makes this phylum evolutionarily resemble chordates?

5. How can the symmetry and the nervous system be described in echinoderms?

7. Do echinoderms use internal or external fertilization? Are they divided into separate sexes?

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