

Phylum Echinodermata

Basics:

- ~ 6000 Living species and 13000 fossil species
- Called the Spiny skinned animals-- from the Greek words:
 - Echinus meaning spiny
 - Derma meaning skin
- Found in all oceans around the world
- Larvae are bilaterally symmetrical, but the adults are mostly radial symmetry (most have pentaradial symmetry as they have 5 rays)
- All are marine organisms
- Move via hydraulic suction cup-tipped appendages called rays
- They do not have segments
- They are coelomates
- Capable of regeneration
- The ventral surface is called the oral surface and has their mouth
- The dorsal surface is called the aboral surface and has its anus
- It has a simple nervous system, but does not have a head or a brain instead it has a nerve net/nerve ring
- They either have no circulatory system or a greatly reduced one
- Have water-filled canals called the water vascular system and tube feet to help move and feed.
- All have a mouth.
- They are deuterostomes (their blastopore forms an anus)
- They have separate sexes
- They reproduce sexually or asexually
- Thought to be closely related to the chordates (you are a chordate)

Body Structures:

- Ray: Arm
- Tube feet:
 - Look like mini eyedroppers
 - On the underside of arms
 - Help move and feed
 - Hollow, thin walled tubes with a suction cup on one end and the other end is the ampulla which has muscles that contract and relax
 - When they contract, it pushes water into the suction cup part so they lengthen and stick to the surface that they are touching.
 - When they relax, water flows back out, so they shorten and release their grip.
 - Each tube foot works independently of one another
 - Function in gas exchange, excretion, and locomotion
 - Excretion and gas exchange occurs via diffusion through the thin walls of the tube feet.
- Madreporite:
 - From the Latin term mater meaning mother and the Greek word poros meaning channel.
 - It is a disc-shaped opening of the echinoderm body (a sieve like strainer)
 - It is the main channel through which the water flows in and out of the starfish.
- Have light and touch detecting cells, but no sense organs
 - Starfish are an exception: they have eyespots on the tip of each ray for light detection.

- Have a dermal skeleton
 - Spiny plates
- Central disc: all rays radiate outward from this and it houses the stomach, madreporite, mouth, and anus
- Water Vascular System:
 - A hydraulic water pressure system
 - Used for locomotion (provided water for tube feet to function)
 - Aids in gas exchange, food capture, and excretion

Regeneration:

- Body regenerating parts
 - Replace missing rays that are broken off by predators or scuba divers.
- Gut Reaction
 - Expel their internal organs into the water (ie: sea cucumber)
 - Tentacles, pharynx, intestines shoot out the anterior end
 - Part of the Respiratory system/digestive and reproductive structures erupt from the posterior end
 - This process gives the organism long enough to escape from predators
 - Then they grow them back.
- Part regenerating a body
 - Linckia genus of starfish can regenerate a whole new organism from a single ray
 - From the end that the ray was detached, a central disc and other rays will grow.

Sexual reproduction:

- External fertilization
- Sperm in testes/eggs in ovaries are released into the water.

5 Classes:

- Asteroidea
- Ophiuroidea
- Echinoidea
- Holothuroidea
- Crinoidea

Class Asteroidea:

- Aka Class Stelleroidea
- Sea stars
- Starfish (misnomer because they are not a fish)
- ~1500 species
- 5 arms radiate out from the central disc (some species have 40 or more, but most have 5)
- Aboral surface has the madreporite and spines
- Oral surface is the underside and has the mouth at the center and ambulacral grooves that are filled with tube feet.
- Usually sedentary
- Live along shorelines
- Come in a variety of colors
- Prey on bivalves (mollusks-clams; oysters)
- Can regenerate its arms
- Size: 1cm to 1 meter
- Endoskeleton of calcium plates
- External fertilization
- 200,000,000 eggs are produced in one season by a single starfish

- Eyespots are present on the tips of each ray that allows them to distinguish between light and dark, but does not form images
- Radial nerve cord
 - Run down the center of each arm
 - Thick/white
 - Can see it if you separate the tube feet
- Male/female
 - Differentiate by mincing the gonads and viewing with a microscope to see if you have:
 - Sperm- flagellated
 - Eggs- large spheres
- Hepatic caecae- branching digestive glands
- Surrounding each spine are pedicellariae
 - 2 jaws moved by muscles to open/close on touch
- Pincer like structures- keep body surface clear of debris and aid in the capture of food.
- Skin gills- function in respiration
- Feeding:
 - When eating it pushes its stomach out of its mouth and spreads it over its food then it secretes enzymes to break down the food into a liquid that it absorbs and pulls back into its body.
 - They open bivalves by wrapping its rays around the shell and applying suction force with its tube feet just enough to insert its stomach into the shell
 - Carnivores- prey on worms and mollusks (bivalves like clams)

Class Ophiuroidea:

- Brittle Stars
- ~2000 species
- 5 arms, but incredibly slender
- Ambulacral grooves are closed
- Tube feet have no suckers and are used very little for motion
- Use their entire arm for movement
- Madreporite is on the aboral surface
- There is no anus, the wastes/food is expelled from the mouth
- Largest class of echinoderms
- Live in the bottom of the ocean under stones, in holes, or crevices
- Long, very flexible narrow arms
 - Break off often and regenerate
- Much quicker than a starfish
 - Do not use tube feet for motion
 - Instead they slither with their entire arms
- Feed on detritus
- Common in coral reefs
- Hide in daylight
 - Move around in darkness
- Very fragile-
 - If you try to pick them up they break
 - Broken off arms will continue to move
 - Distracts predators

Class Echinoidea:

- Sea urchins and sand dollars
- Internal organs are enclosed in a test of fused skeletal plates
- Have a jawlike crushing structure (Aristotle's lantern) to grind food
- Use tube feet to move
- Herbivores: eat algae
- Regular sea urchins:
 - Compact body encased in a "test" or shell
 - Lack arms/ rays
 - Move via tube feet and spines
- Irregular sea urchins and sand dollars
 - Very short spines
 - Flattened bodies
 - Move via spines
 - Bilateral symmetry
- Sea urchins
 - Some species have long barbed spines that make poisonous fluids/venom that they inject into attackers/predators
 - Spherical in shape
 - Live on the ocean bottom
 - Feed on algae with 5 part jaw like structures that they scrape rocks with
 - Live in rocky areas and wedge themselves in rock crevices during the day.
- Sand dollars
 - Flat bodies
 - Live in the sand along coastlines
 - Are shallow burrowers
 - They burrow under the sand/mud for protection
 - Have short spines that dissolve when they die

Class Holothuroidea:

- Sea cucumbers
- ~1500 species
- Elongated
- Soft bodied with a leathery tough skin
- Well developed tube feet along one ambulacral groove
 - 5 rows of tube feet
 - Run lengthwise along the ambulacral groove
- Bilateral symmetry
- Lack arms
- Pickle or cucumber shaped
- Have fragile tentacles, which are modified tube feet, around its mouth
 - They are sticky on the ends
 - Allow them to eat plankton
- Feed on detritus too
- Bulldoze across the ocean floor to find food
- Tend to herd together in 100's to thousands
- Eject parts of their internal organs to scare predators
 - Regenerate the parts in a few days
 - Or they can expel tangled masses of tubes from their anus

Class Crinoidea:

- Sea lilies, feather stars
- ~600 species
- Feather stars: Sessile only in the larval form, adults use their feathery arms to move
- They are the only sessile echinoderms—but they can detach and move around
- Body disc has leathery skin and calcareous plates
- 5 flexible arms that branch to form many more arms
- Ambulacral grooves are open and ciliated
 - Serve to catch organisms and carry them to its mouth
- They have a long stalk with long feathery branching arms
- The mouth and anus are on the upper surface
- They have 5-200 arms
- Nocturnal feeders
- Common in areas with strong currents
- Feed on detritus (dead decaying material)
- They filter feed
 - Tube feet capture floating plankton
- They are the oldest of the echinoderms
- Common in tropical oceans
 - Many live on coral reefs