

Synopsis of Phylum Echinodermata

Identifying Characteristics of the phylum

- means “prickly skin”; include: starfish, sea cucumbers, basket stars, brittle stars, sea lilies, etc
- has an extremely abundant and diverse fossil record; much more diverse fossil record than species existing today
- all marine; found in all oceans at all depths; some of the most abundant of all marine animals
- almost all are **bottom dwellers**
- only **major** invertebrate phylum with affinities for vertebrates
- most with **pentamerous** (=pentaradial) **radial symmetry**
- outer surface covered by **epidermis**; below epidermis is thick dermis made of connective tissues
- dermis secretes skeletal pieces (= **ossicles**) = **endoskeleton**
- echinoderms can vary rigidity of dermis = “catch collagen”
- water vascular system**; **madreporite** leads to **stone canal**, joins **ring canal** around the mouth, **radial canals** extend into each arm, **lateral canals** branch off, lead to **ampullae**, connected to **tube feet**
- echinoderms are particle feeders, scavengers or predators; no parasitic species
- simple, usually complete digestive tract; **stomach** has 2 chambers: **cardiac & pyloric**; digestive enzymes are secreted into stomach by **pyloric caecae**
- respiration by **dermal branchiae** (or papulae)
- no brain or centralized processing area; **circumoral ring** and **radial nerves** branching from it
- few specialized sense organs; have some simple **tactile**, **chemical** and **photoreceptors** and **statocysts**
- in many starfish the body surface bears small jaw-like **pedicellariae**
- sexes typically separate → dioecious; external fertilization; planktonic bipinnaria larva
- some can also reproduce **asexually** by **fragmentation**; excellent powers of **regeneration**

Class: Asteroidea (sea stars, starfish)

- inhabit all seas except low salinity areas
- bottom dwellers; mostly found on hard rocky surfaces; many live in deep ocean
- body composed usually of 5 rays (**arms**) projecting from a **central disc**
- mouth** in center of oral surface
- wide furrows project from mouth into each arm = **ambulacral grooves**
- aboral surface with **madreporite** toward one side & numerous **pedicellariae**
- movement mainly by tube feet
- many sea stars are **scavengers**; a few are **suspension feeders**; most asteroids are **carnivores**
- many starfish regularly reproduce asexually
- most are dioecious; **gonads** in small area at base of each arm; most produce free swimming larvae

Class: Ophiuroidea (brittle stars, basket stars, serpent stars)

- the most active of the phylum
- found in all types of **marine benthic habitats**; mainly **benthic**; tend to be secretive
- long thin **arms** sharply set off from **disc**; no ambulacral groove; visceral organs confined to central disc
- locomotion by snake-like arm movements; **muscles** are much more important in this group; **ossicles** of arms are arranged into flexible columns (called “vertebrae”) connected by muscle strands
- brittle stars are **carnivores**, **scavengers**, **deposit feeders** or **filter feeders**
- mouth on oral side has 5 jawlike plates; incomplete digestive tract
- no dermal branchiae’ brittle stars have internal sacs called **bursae** for respiration
- gametes discharged through the genital slits to the outside; some brood their young in the bursae
- brittle stars can spontaneously cast off arms; the pieces can regenerate into whole brittle stars

Class Echinoidea (sea urchins, heart urchins, sand dollars & sea biscuits)

- widely distributed in all seas; all are **benthic**; seem to prefer hard substrates
- compact body enclosed within a test (or shell) of closely fitting **ossicles** sutured firmly together
- no arms, but 5 **ambulacral areas** on test through which **very long tube feet** extend; with long spines
- mouth with **Aristotle's lantern**; used to scrape and chew algae from rocks
- use very long tube feet and prehensile spines to move
- most sea urchins are **grazers**; scrape algae from substrates with teeth

Class: Holothuroidea (Sea Cucumbers)

- rule the deep ocean benthos → make up 90% of biomass on deep ocean floor
- like sea urchins have no arms
- tend toward **bilateral symmetry**; with mouth and anus are on opposite ends
- body has a leathery appearance; ossicles reduced to microscopic plates embedded in body wall
- mouth is surrounded by 10-30 **tentacles** (modified tube feet)
- large fluid filled coelomic cavity serves as a **hydrostatic skeleton**
- mainly **deposit feeders** and **suspension feeders**; use **tentacles** to collect food and deliver it to **mouth**
- mouth opens into a muscular **pharynx**; then to **esophagus** and **stomach**, then a long, looping **intestine** leads to **anus** which opens into **cloaca**
- most have a **respiratory tree** for respiration & excretion
- many sea cucumber are capable of **evisceration**; the organs are later regenerated
- some also have **tubules of Cuvier** that can be aimed and shot out of the anus for protection
- most are dioecious; a few are hermaphrodites; some brood their young inside coelom

Class: Crinoidea (sea lilies, feather stars)

- an ancient group; many fossil species
- some are stalked sessile animals; others are free living and motile
- most live at depths of 100 M or more
- flower shaped body; body disc, = **calyx**, is covered in leathery skin
- upper surface of calyx bears **mouth** and **anus**; arms have **pinnules** giving feather-like appearance
- no madreporite, spines or pedicellariae
- crinoids are suspension feeders
- very slow metabolism
- can probably live for 1000's of years
- dioecious; either brood eggs or release them

Ecological Role of Echinoderms

- a wide variety of other animals make their homes in or on echinoderms
- sea stars are often the top predators in some benthic communities
- though unpalatable to most organisms to some they are the preferred meal: eg. some fish with strong teeth, eg. sea otters
- “crown of thorns” starfish destroys Pacific coral reefs; feed on coral polyps; sometimes attack in “herds”
- sea urchins destroy kelp forest

Economic/Human Impacts

- echinoderms never attack humans; don't transmit any diseases
- handling poisonous forms can kill
- predatory starfish can devastate commercial clam or oyster beds
- in China and Pacific Islands sea cucumbers are eaten as a delicacy
- roe (gonads & eggs) are sold, raw or roasted, as a delicacy in Japan and in sushi restaurants
- echinoderms have been widely used in developmental research