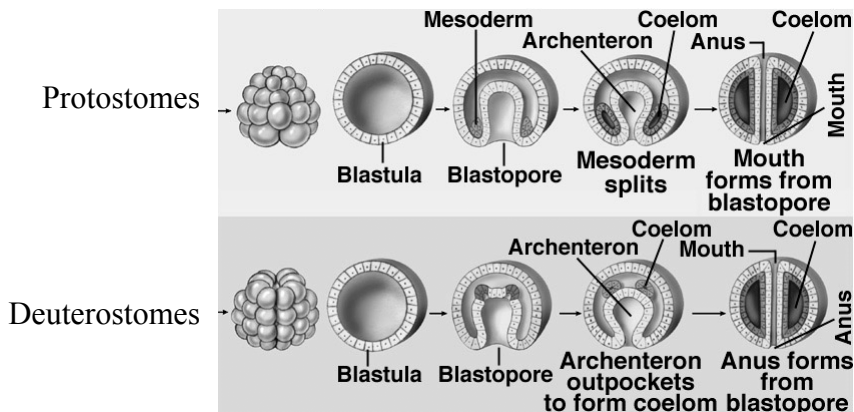
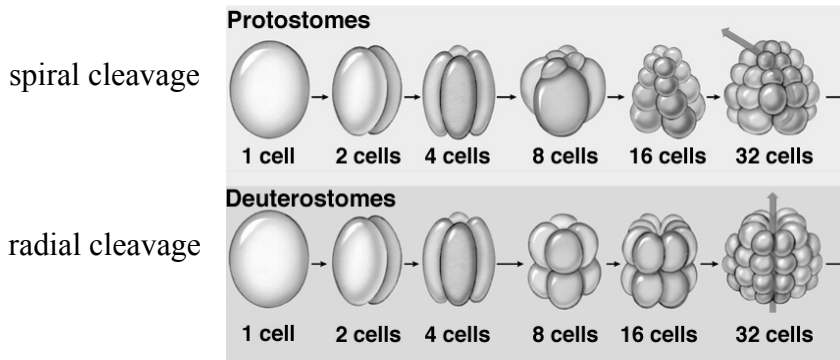


Coelomates: Protostomes and Deuterostomes

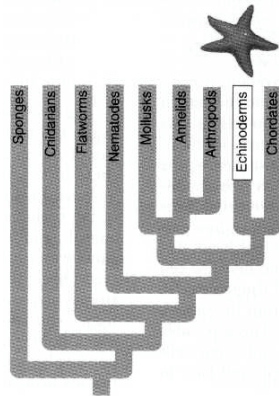
Protostomes have spiral cleavage, the blastopore becomes the mouth, mosaic development - mollusks, annelids, arthropods

Deuterostomes have radial cleavage, the blastopore becomes the anus, regulative development - echinoderms, chordates



Phylum Echinodermata - Echinoderms

includes starfish, sea urchins,
sand dollars, sea cucumbers



Name means “spiny skin” - have
hard endoskeleton, often with spines
below thin skin

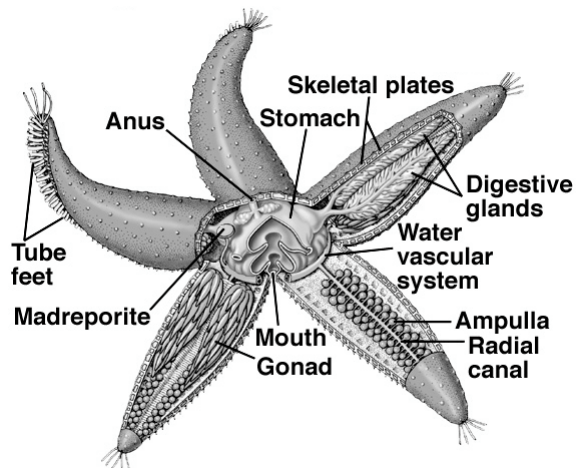
Endoskeleton is made of calcium carbonate plates that form internally
Possess a unique water vascular system - a hydraulic system to aid
movement and circulation

Mouth opens ventrally in most - anus is dorsal

Adults have no head or
brain

Nervous system
composed of circular
nerve ring and radial
branches

Sexes are separate
Fertilization is external
Gonads (ovaries and
testes) found in arms

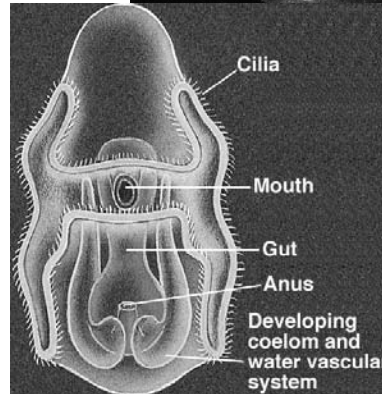
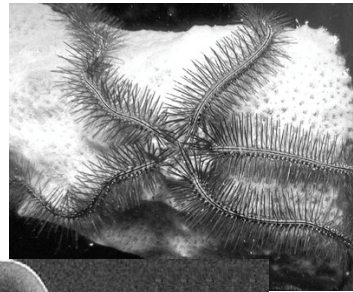


Echinoderms exhibit radial symmetry as adults - but have a bilaterally symmetric larva

Transform to pentaradial symmetry as they mature

Radial symmetry works well for sessile organisms - primitive echinoderms (like sea lilies) are sessile

Bilateral larva thought to indicate that they originated from a bilaterally symmetric ancestor - original ancestor is uncertain



The Water Vascular System

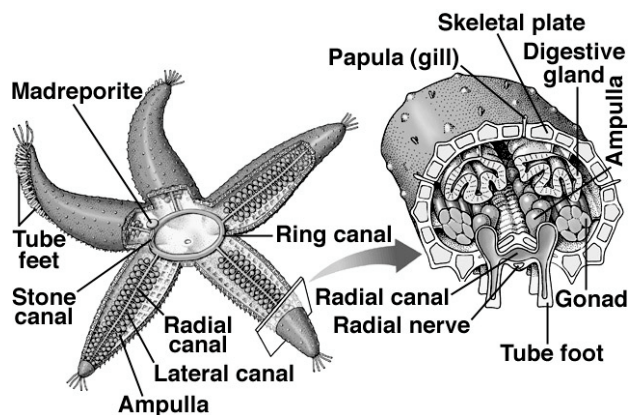
Five radial canals extend from a ring canal around the esophagus

Water enters through madreporite, a sieve-like plate

Flows to ring canal through the tubular stone canal

Radial canals have lateral canals to tube-feet

Each tube-foot has a muscular fluid-filled ampulla at its base



Operation of the water vascular system

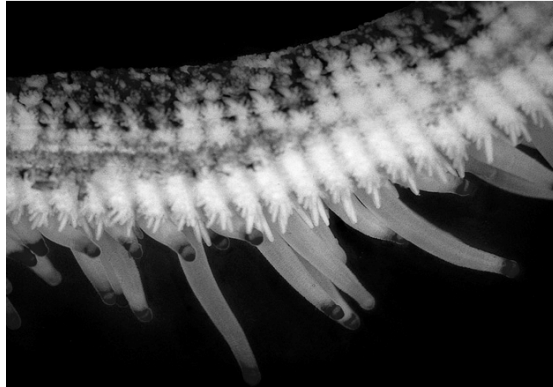
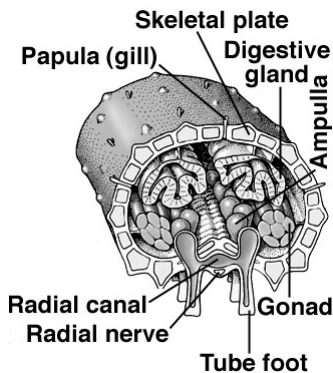
Ampulla contracts, one way valve causes fluid to be forced into tube-foot - results in extension

Foot can attach to substrate, sometimes with suction-cup tip

Longitudinal muscles contract and shorten tube-foot

Water forced back into ampulla

Repeated movement results in locomotion or manipulation of objects



Have large coelom, lined with cilia
Helps provide for circulation and respiration

In most, respiration and waste removal occur through skin gills (papulae) that project through skin

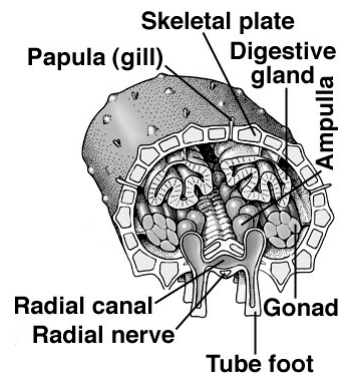
Endoskeleton composed of ossicles
Movable or fixed plates under skin
Tube feet extend through perforations

Reproduction - many species capable of extensive regeneration
may shed body parts when attacked -

some reproduce asexually by splitting into parts

Sexual reproduction and fertilization is external

Sexes are separate, have free-swimming bilaterally symmetric larva



There are Six Living Classes of Echinoderms

Crinoidea - sea lilies and feather stars

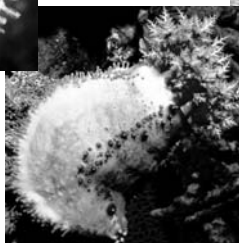
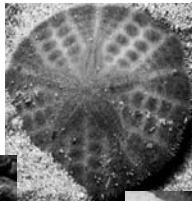
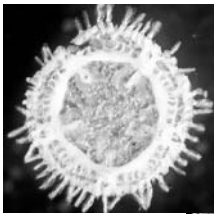
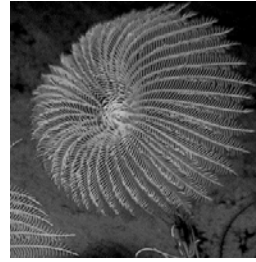
Asteroidea - sea stars

Ophiuroidea - brittle stars

Echinoidea - sea urchins and sand dollars

Holothuroidea - sea cucumbers

Concentricycloidea - sea daisies - recently discovered



Class Crinoidea: The Sea Lilies and Feather Stars

Sessile, sedentary animals

Mouth and anus located on upper surface of an open disk

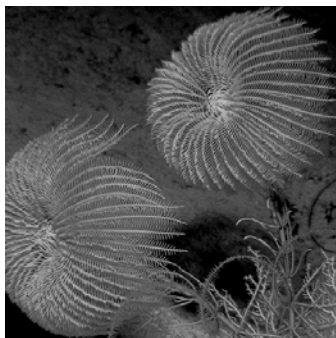
Many highly branched arms located around central disk - 5 to 200 arms - smaller pinnules branch from each arm

food collected by mucus on pinnules - transported by tube-feet

Fossils abundant, many more extinct forms than living species

Sea lilies
have a stalk

Found in
water deeper
than 100 m



Class Asteroidea - Sea Stars

the familiar "starfish"

Active, important marine predators

Abundant in shallow and deep waters

Arms merge gradually with disk

Arms in multiples of five, usually five

Body flattened, flexible, covered with pigmented epidermis



Often feed on bivalves

Grasp shell with tube feet to wrench open

Extrude stomach into shell

Secretes enzymes, digests soft parts of bivalve



Many are scavengers

Class Ophiuroidea - Brittle Stars

Largest class of echinoderms

Called "brittle" because they shed their arms readily

Found in shallow water and one of most abundant animals in the deep-sea

Slender arms set off sharply from central disk

Actively move arms for locomotion

Arms may be covered with spines

Some use arms to swim

Tube feet are important sensory organs

Tube feet capture small food particles and move food to mouth

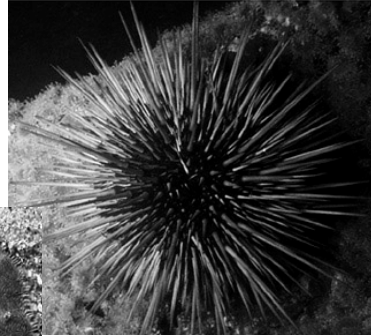
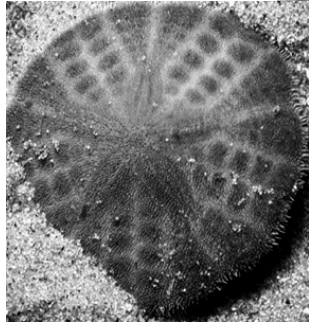


Class Echinoidea - Sea Urchins and Sand Dollars

Lack distinct arms, but still have five-part body plan
Five rows of tube feet protrude from plates of skeleton
Endoskeleton is made of fused plates
Sea urchins are globular with large spines
Sand dollars are flattened

Walk with tube feet or
movement of spines

Feed on algae
scraped off the
surfaces by
triangular teeth or
feed on food items
found on or in the
substrate



Class Holothuroidea - Sea Cucumbers

Soft, sluglike organisms with tough, leathery skin
Bilaterally symmetric externally, with five-part internal body plan
Mouth is located on one end, anus on other
Mouth surrounded by tube feet modified into tentacles
Tentacles secrete mucus to trap food particles

Endoskeleton reduced to widely separated,
microscopic plates

Respiration by respiratory tree that
originates at anus

Have tube feet on body

Move by tube feet or flexing of entire body

Most are sluggish

May eject digestive system or respiratory
tree when threatened by a predator

