

Echinodermata (sec 27.1)

Echinoderms

- approximately 6000 species of echinoderms
- all species are marine → Aquatic (Salt H₂O)
 - no echinoderms are found in freshwater or on land
- Echinoderms have a coelom
 - fluid filled cavity
 - tissues to enclose organs
- all echinoderms display radial symmetry as adults, but have larva that are bilaterally symmetrical
- Echinoderms are the first group of animals in evolutionary history to contain endoskeletons
 - an internal skeleton that provides support and protection and can act as a brace for muscles to pull against
 - usually consists of calcium carbonate plates and spines
- Pedicellariae - small pincers that aid in catching food and in recovering foreign material from the skin
- Echinoderms arms or body plans are arranged in 5's or some multiple of 5

Echinoderm Diversity

6 Major Classes

1. Asteroidea
2. Ophiuroidea
3. Echinoidea
4. Crinoidea
5. Holothuroidea
6. Concentricycloidea

Class Asteroidea → sea stars (starfish)

- most have 5 arms arranged around a central disk
- found in shallow water near the shore
- use tube feet for movement and feeding
- feed on mollusks and bivalves



Class Ophiuroidea → brittle stars

- most have 5 arms but arms are very brittle and flexible
- do not have suckers on their tube feet (no suction cups)
- use their arms for movement
- arms can be regenerated when damaged



Class Echinoidea → sea urchins and sand dollars

- burrowing is a key characteristic for these organisms
 - sea urchins burrow in rock and sand dollars burrow in sand
- have a compact body that is enclosed in a hard endoskeleton called a test
- close fitting plates of calcium carbonate make up the test
- lack arms but test reflect pattern of 5



Class Crinoidea → sea lilies and feather stars

- the most ancient of all echinoderms
- sessile for part of their lives
- sea lilies have a flower shaped body at the top of a long stalk
- feather stars have long-branched arms that radiate from a central area



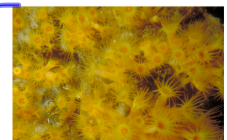
Class Holothuroidea → sea cucumbers

- cucumber shape
- leathery outer body
- tube feet modified to tentacles near mouth
- only echinoderms to have respiratory organs in the form of respiratory trees
- * when threatened, the sea cucumber can cast out some of its internal organs through its anus



Class Concentricycloidea → sea daisies

- less than 1 cm in diameter
- no arms
- tube feet located around the edge of a disc



Water-Vascular System

- A system of fluid filled closed tubes that work together to enable echinoderms to move and get food, breathe
- Madreporite - the strainerlike opening to the water-vascular system
- Water is brought in through the madreporite and then it moves through the stone canal and then the ring canal
 - a tube that connects the madreporite to the ring canal
 - a tube that circles the mouth and connects to the radial canals
- Water then moves from the ring canal to the radial canals
 - tubes that run through each arm of the starfish
- connected to the radial canals are lots of tube feet
 - small, muscular, fluid-filled tubes that end in suction-cup-like structures that aid in movement, food collection, and respiration
- the opposite ends of tube feet contain a muscular sac called an ampulla
- When muscles contract in the ampulla water is forced into the tube foot and it extends
- This hydraulic suction enables echinoderms to move and in some cases helps them pry open shells of mollusks



Feeding and Digestion

- Echinoderms use a great variety of feeding strategies in addition to their tube feet
- some extend their arms to trap food
- some push their stomachs out of their mouths and onto their prey, then they cover their prey with digestive enzymes and use cilia to bring food into their mouths
- some trap food on mucus on their arms
- some use teeth-like plates to scrape algae and food off surfaces

Starfish Digestion

- Starfish have a mouth and an anus
- the mouth is located on the ventral (oral) side of the organism, and the anus is located on the dorsal (aboral) side of the organism
- food is taken in through the mouth and the mouth and then passes through 2 stomachs
 - 1 - cardiac stomach - the larger lower stomach that is capable of being expelled out of the mouth
 - 2 - pyloric stomach - the smaller upper stomach that is connected to digestive glands in each arm
- There are digestive glands located in each arm of the starfish. They secrete digestive enzymes and break food down further
- Waste is expelled through the anus on the dorsal side of the organism

Respiration

- Echinoderms use their tube feet for respiration (starfish do this)
- oxygen diffuses from the water through the thin membranes of the tube feet
- some carry out diffusion of oxygen through all thin body membranes that are in contact with the water
- others have thin-walled skin gills and some have respiratory trees
 - ↳ sea cucumbers

Circulation

- takes place in the body coelom and the water vascular system
- not many structures in the starfish to look at concerning circulation

Excretion

- cellular waste is removed through thin body membranes
- cilia move water and body fluids throughout the systems aided by a pumping action

Response to stimuli

- echinoderms have both sensory and motor neurons with varying degrees of complexity in different species
- In general, a nerve ring surrounds the mouth with branching nerve cords connecting other body parts
- sensory neurons respond to touch, chemicals in the water, and water currents
- Starfish have eyespots
 - clusters of light sensitive cells at the tips of the arms

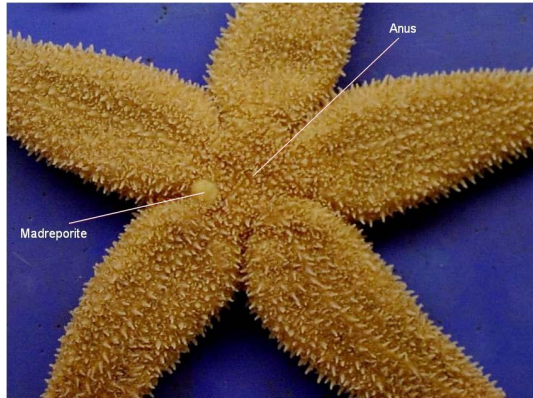
Movement

- movement depends on the echinoderm body shape
- some use tube feet to move
- others grab onto the soft sediment on the ocean floor
- some use their arms to swim (brittle stars)

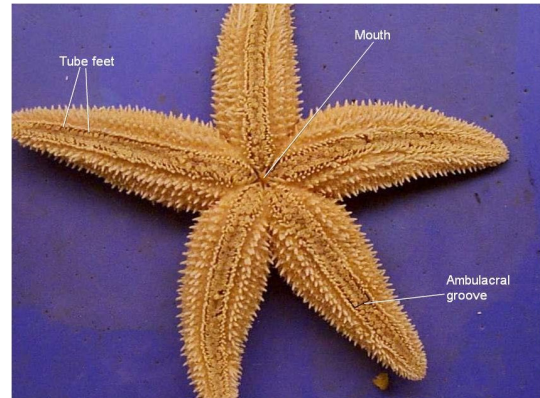
Reproduction

- reproduction is sexual with separate male and females
- fertilization takes place in the water where females release eggs and males release sperm
 - External
- the fertilized egg develops into a bilaterally symmetrical swimming larva
- starfish can also regenerate body parts if they are damaged or lost
- gonads of starfish are located under the digestive glands in the arms

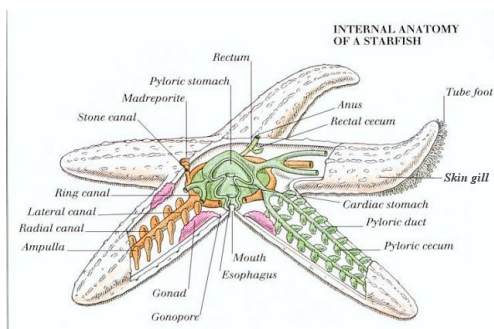
Starfish External - Dorsal (aboral)



Starfish External - Ventral (oral)



Starfish - Internal Anatomy



- Title
 - purpose
 - procedure
 - Data table
 - Calculations
 - Conclusion
 - * Sources of error
 - * Variables that changed
 - * How would you change your design / make it better
- Drawing of design / explanation