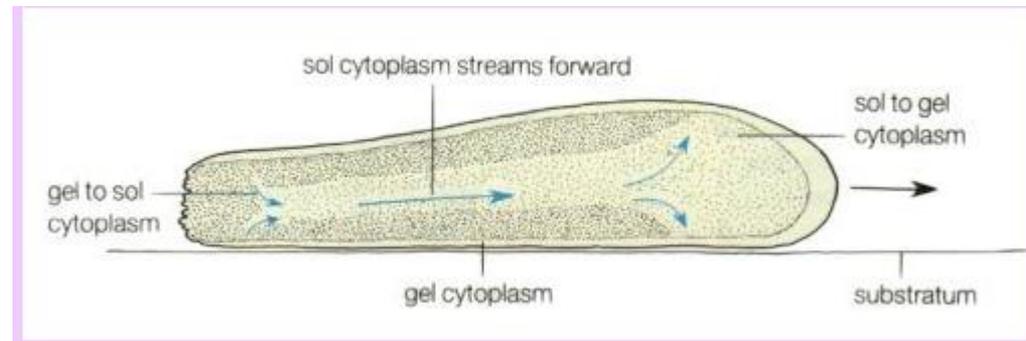
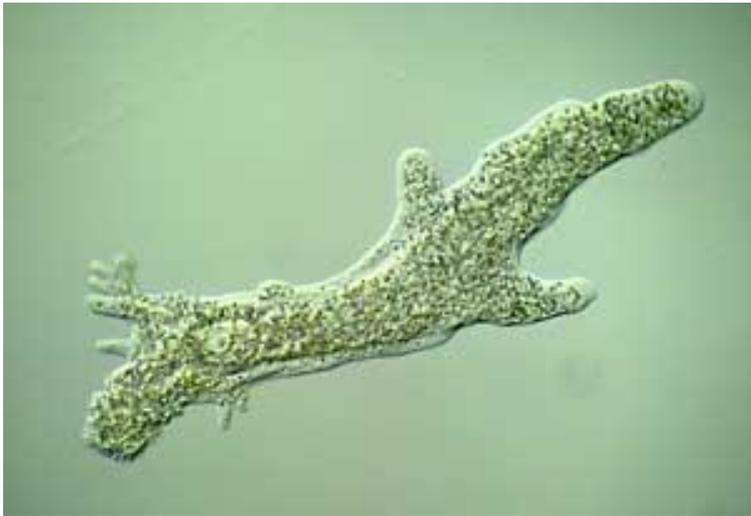


MUSCLE SYSTEM

Animals movements – energy is needed (from ATP)

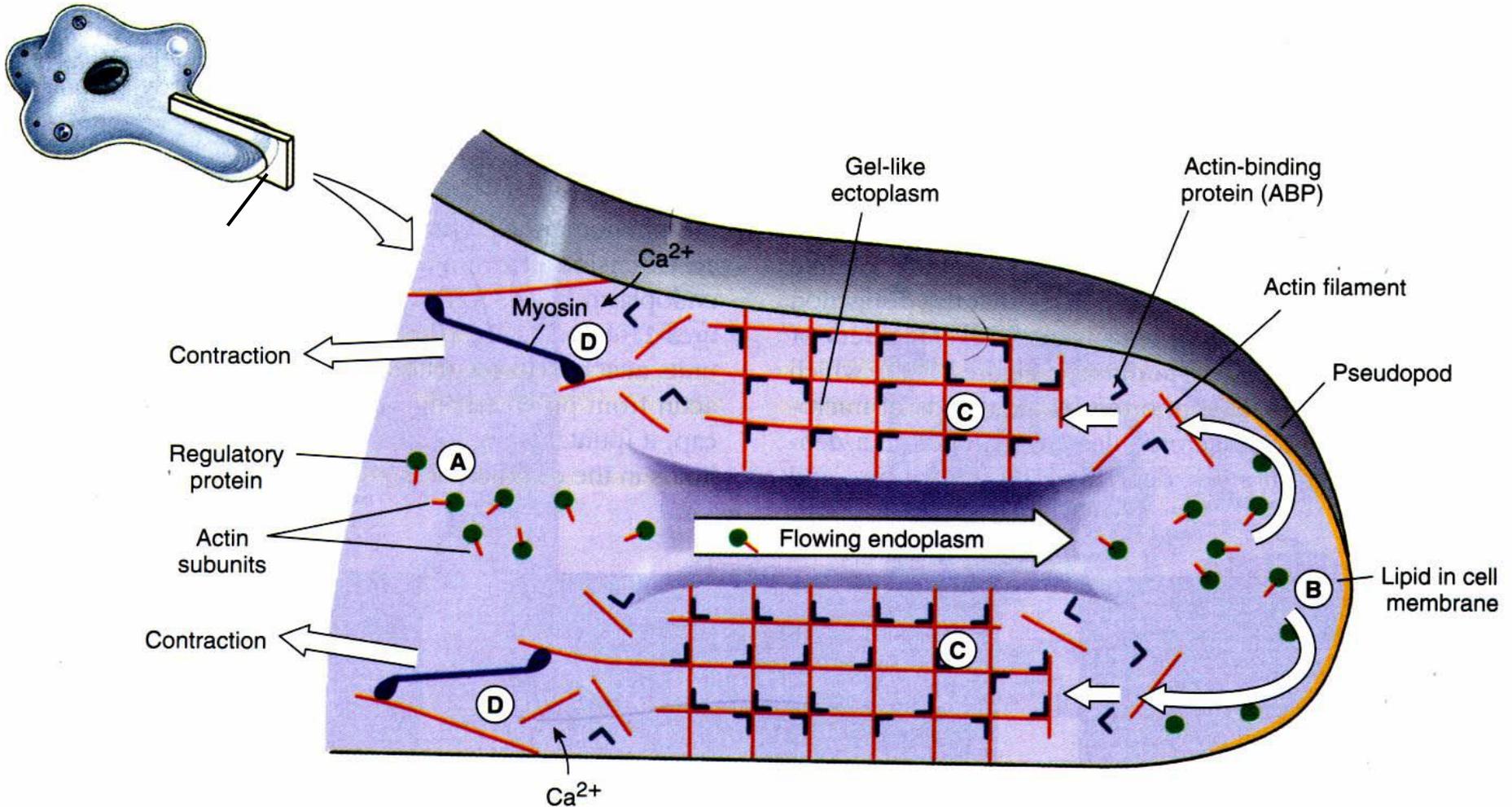
1. Amoeboid movement

- the most common mode of locomotion in eukaryotic cells
- a crawling-like type of movement accomplished by protrusion of cytoplasm of the cell involving the formation of pseudopodia ("false-feet")

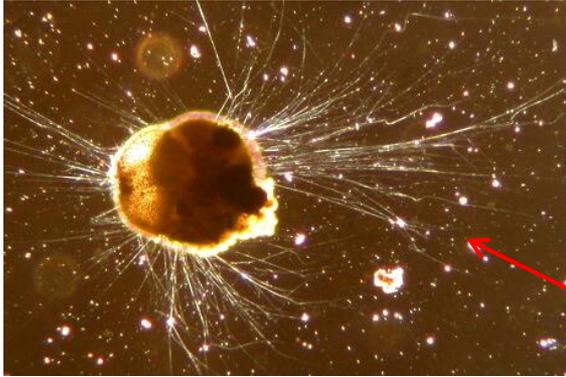


- Microfilaments (protein fibres – **ACTIN** and **MYOSIN**) can contract

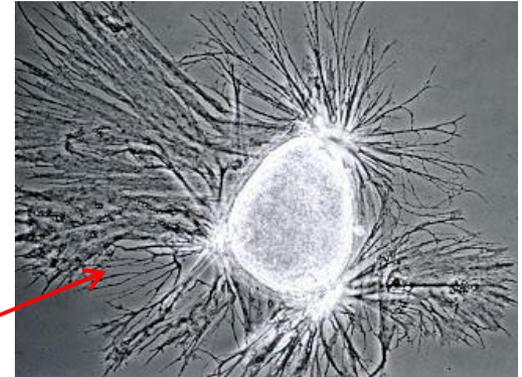
Contraction thus results from an **interaction between the actin and myosin filaments that generates their movement relative to one another**. The molecular basis for this interaction is the **binding of myosin to actin filaments, allowing myosin to function as a motor that drives filament sliding**.



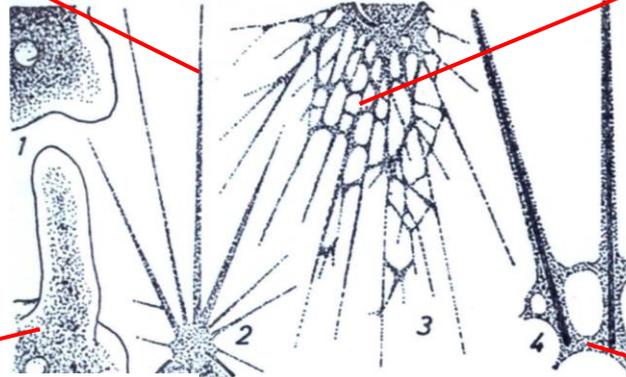
Different shapes of pseudopodia



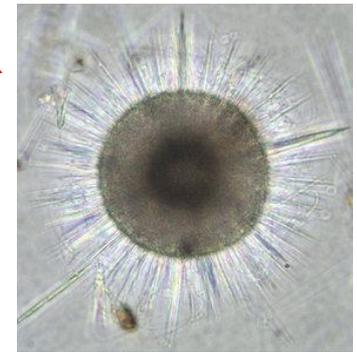
Foraminifera



Foraminifera



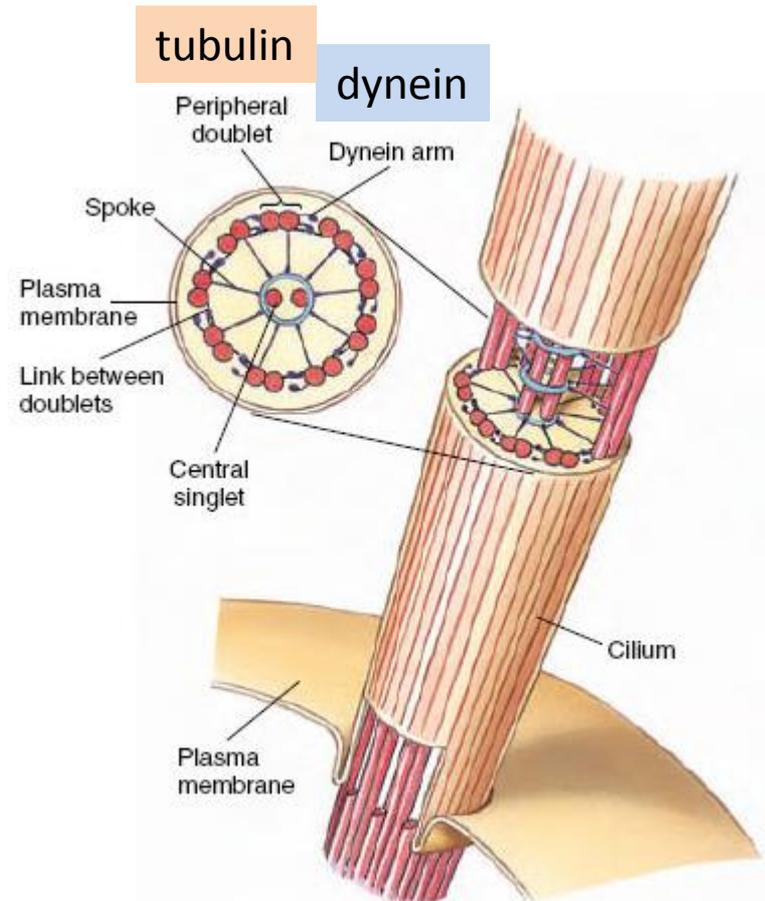
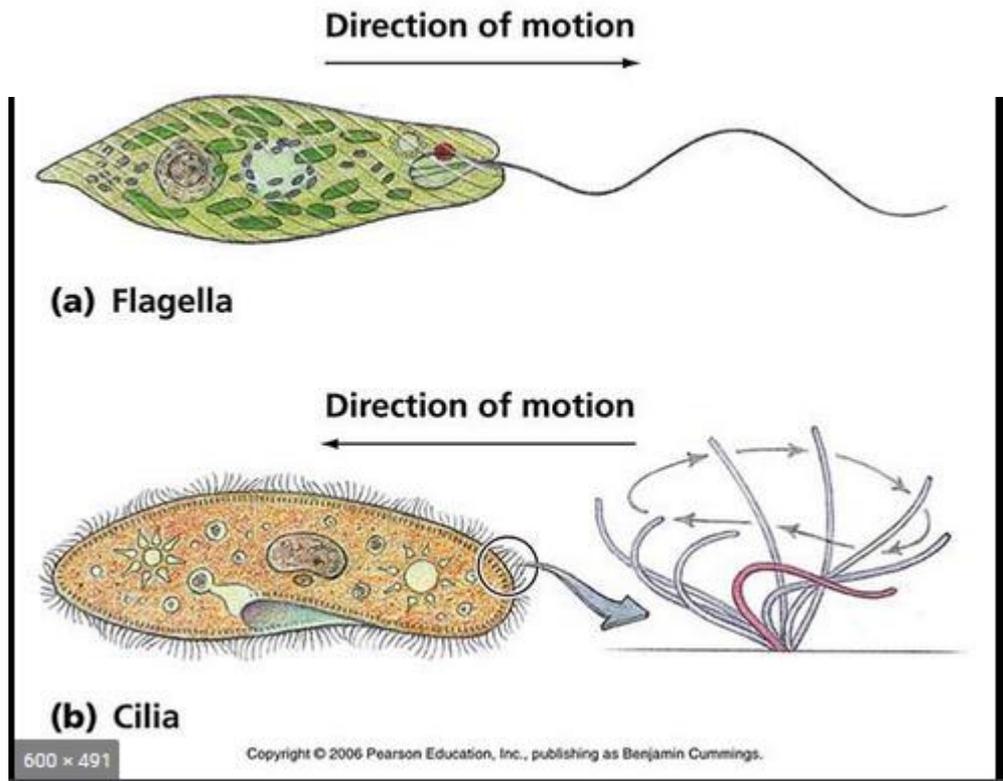
Amoeba



Radiolaria

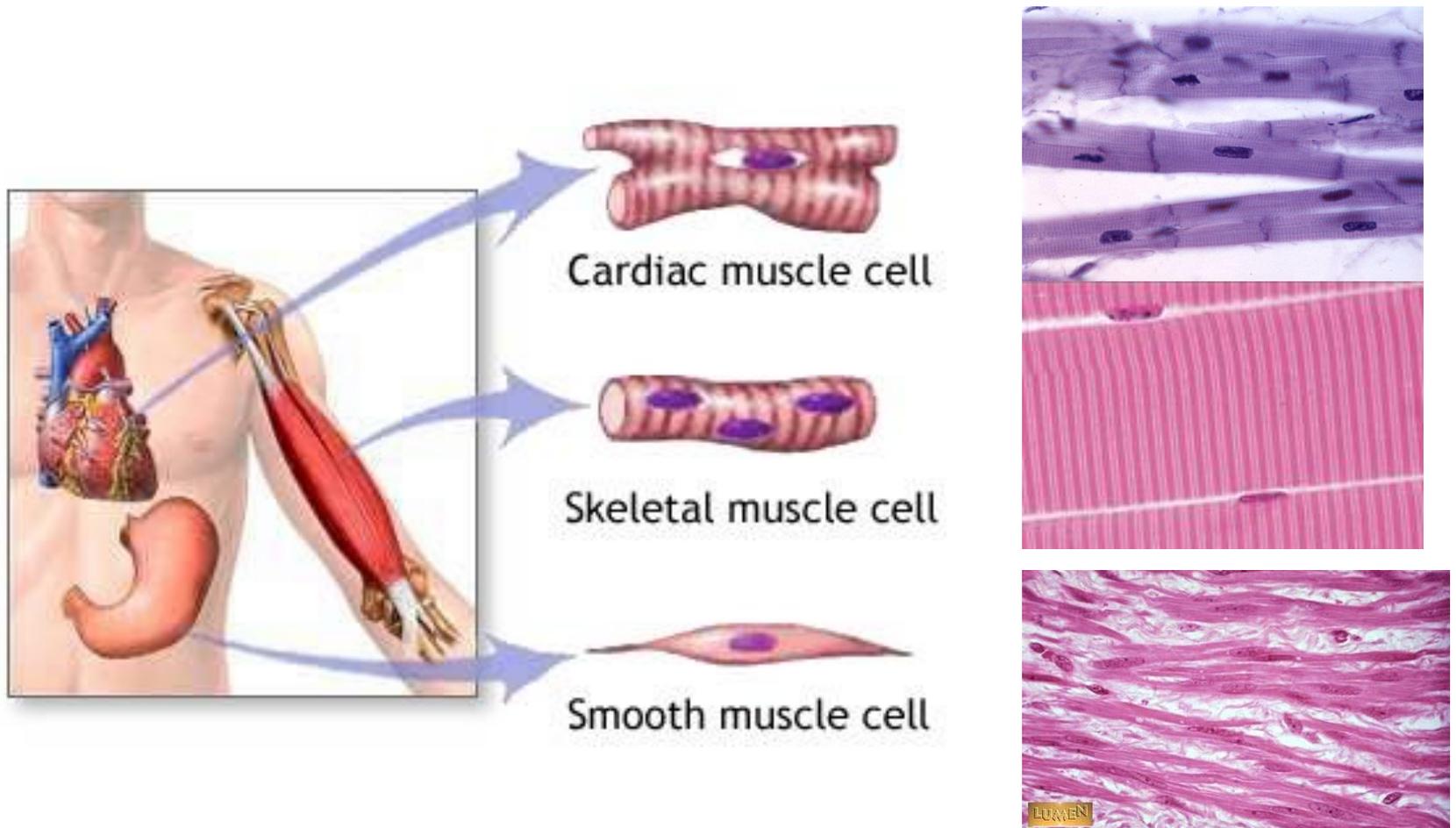
2. Flagellar and ciliary movement

- beating propels cells forward
- despite their different names, flagella and cilia have the same structure, including nine doublet microtubules arranged in a circle around two central singlet microtubules
- Majority of Protista, and many multicellular animals (in different tissues – eg. respiratory system)



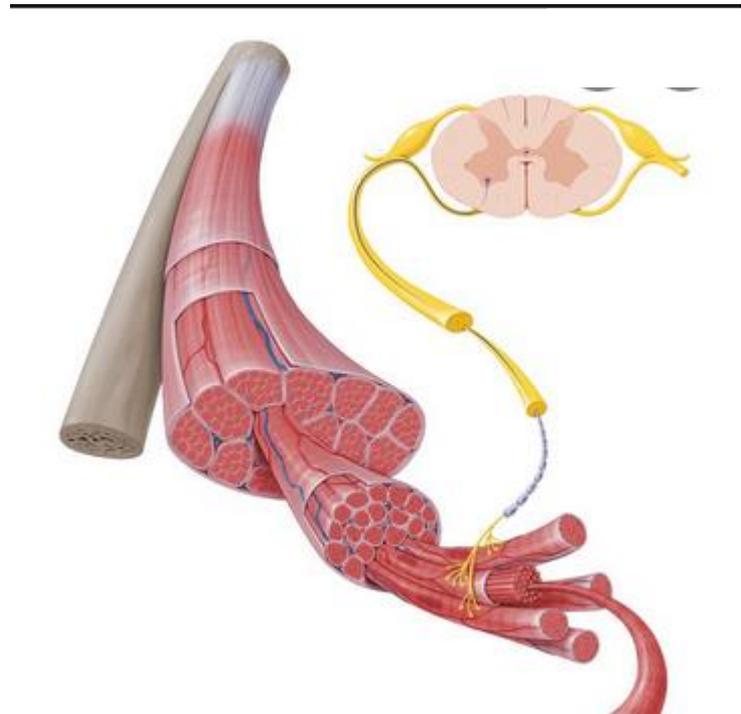
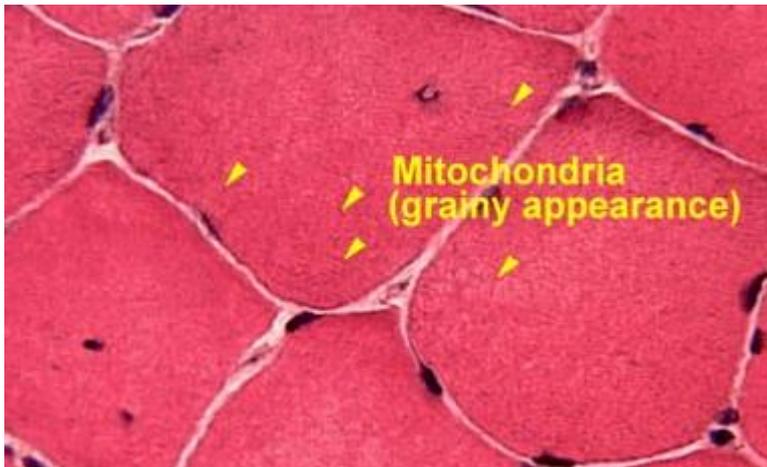
3. Muscle movement

- Nearly all movement in the body is the result of **muscle contraction**
- In addition to movement, muscle contraction also fulfills some other important functions in the body, such as posture, joint stability, and heat production



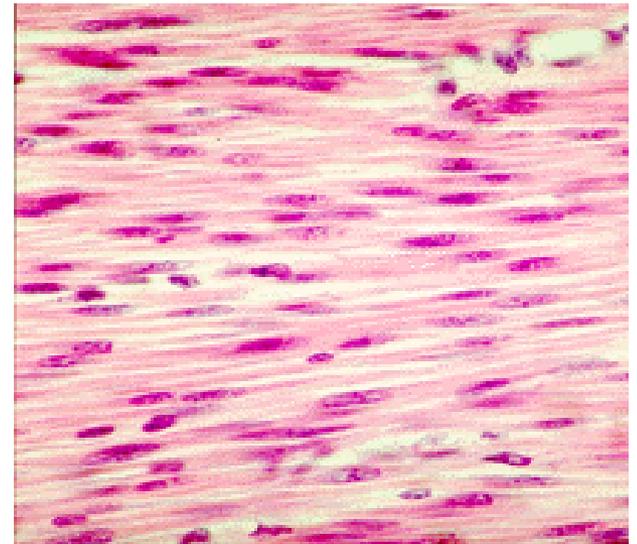
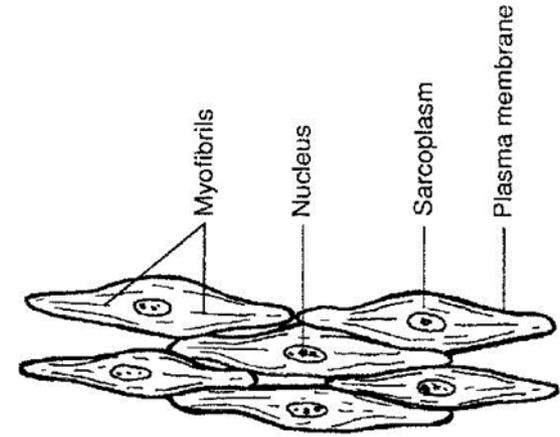
Muscle tissue

- From cells in which cytoplasm contractile proteins developed
- Basic contractile proteins are **ACTIN & MYOSIN** → they join into microfilaments
- Cells are rich in mitochondria (lots of energy)
- Connection to nerves – neuromuscular connection

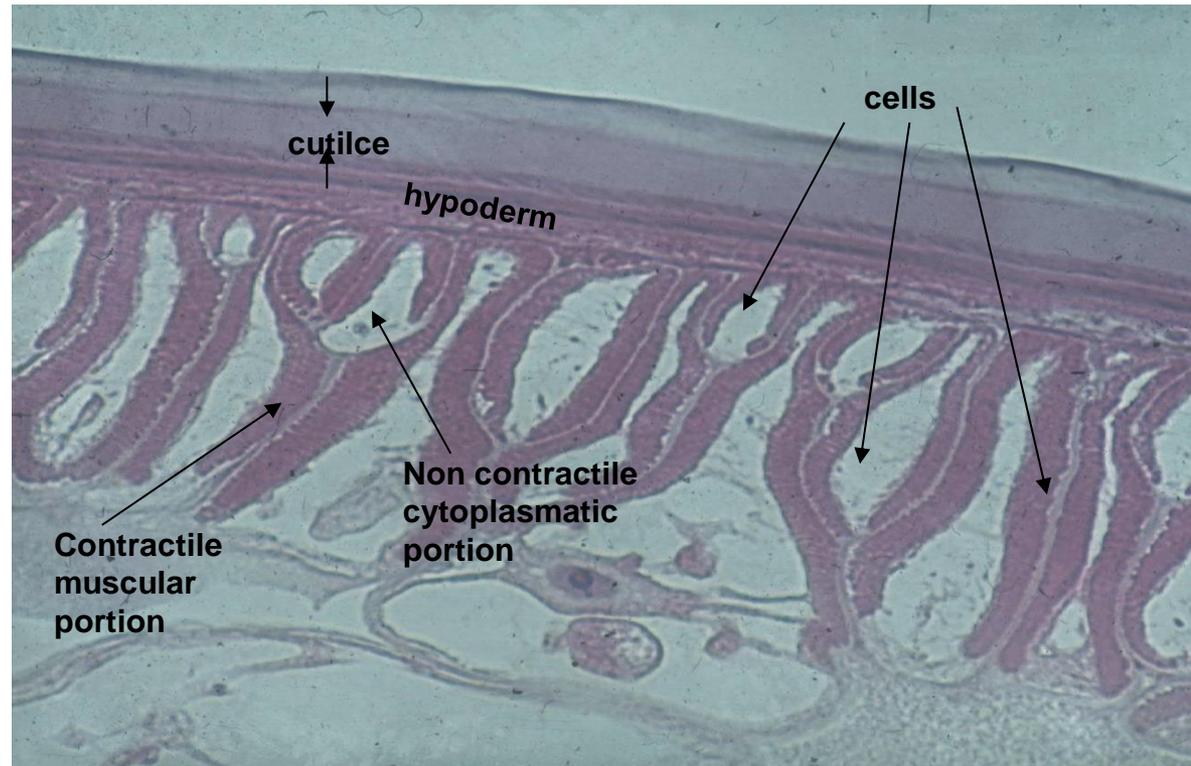
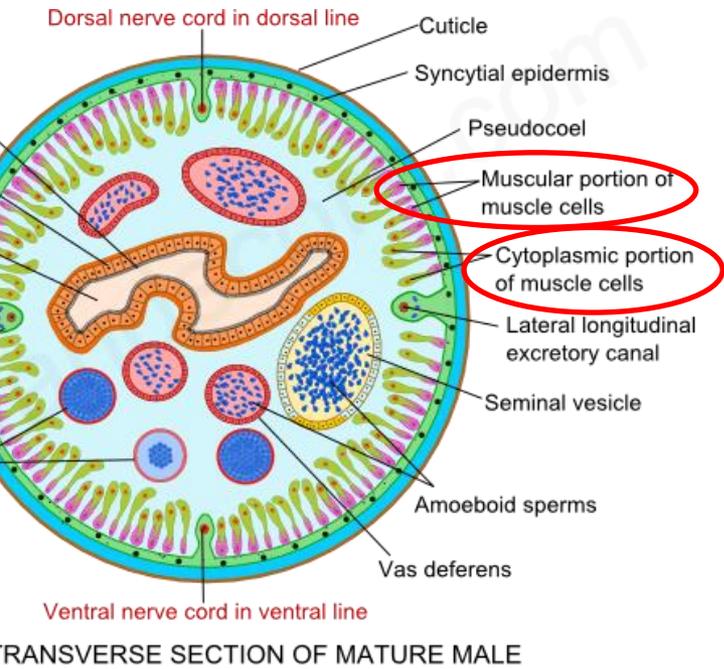


SMOOTH MUSCLE

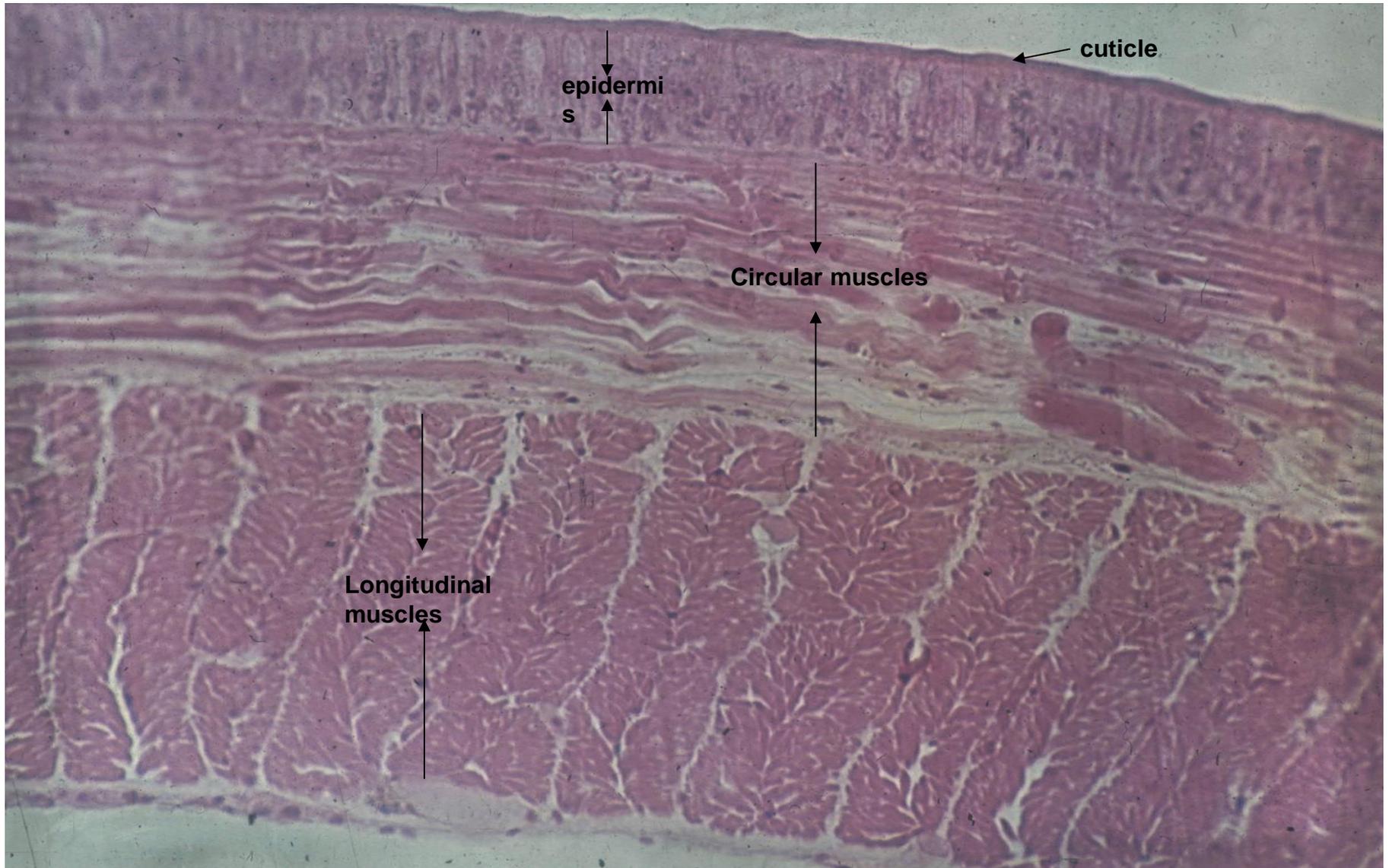
- also called involuntary muscle, muscle that shows no cross stripes under microscopic magnification.
- consists of narrow spindle-shaped cells with a single, centrally located nucleus.
- unlike striated (skeletal) muscle, contracts slowly and automatically
- in **cytoplasm both actin and myosin**
- **build walls of hollow visceral organs in Vertebrates** (such as the digestive tract, respiratory system, some glands, gall bladder, urinary bladder, blood and lymphatic vessels..)
- **build muscle system in Invertebrates**



Ascaris lumbricoides - epithelial-muscle cells

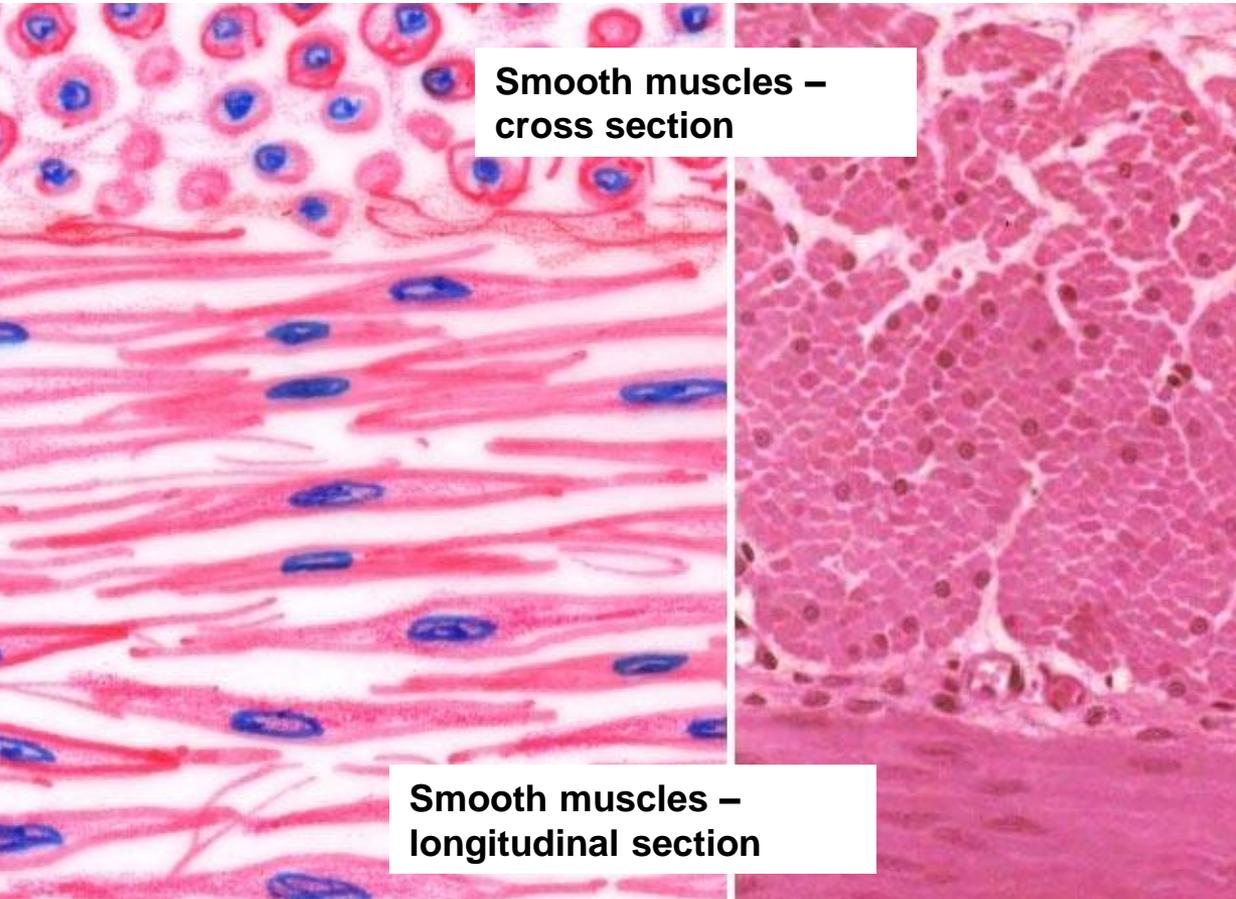
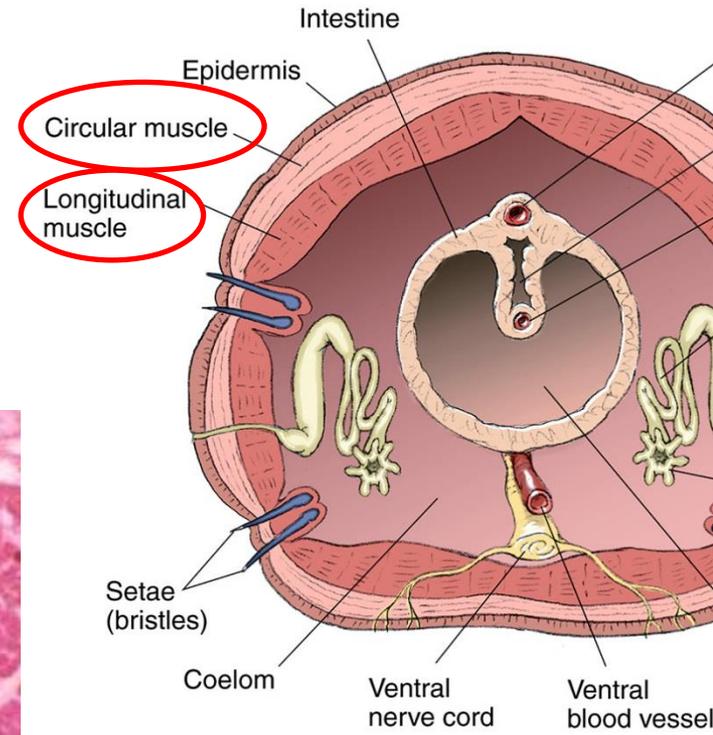


Annelida – earth worm (*Lumbricus terrestris*)





Lumbricus terrestris



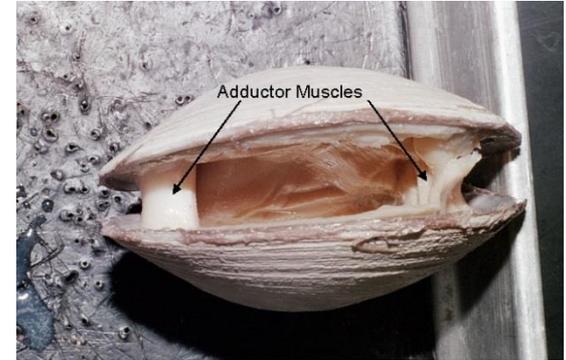
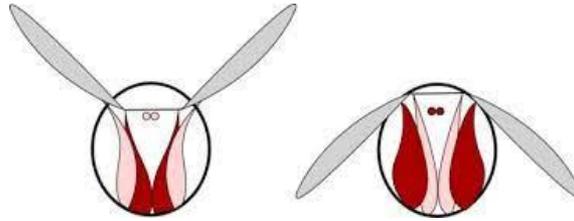
Smooth muscles – cross section

Smooth muscles – longitudinal section

Skeletal/ stripped muscles

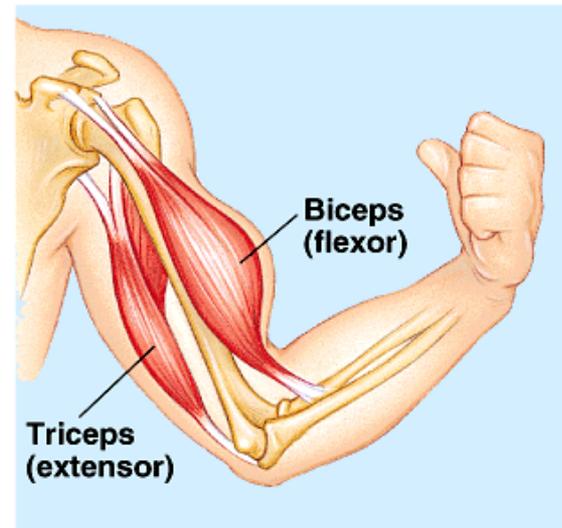
Invertebrates

- Those positions where fast and strong reaction is needed

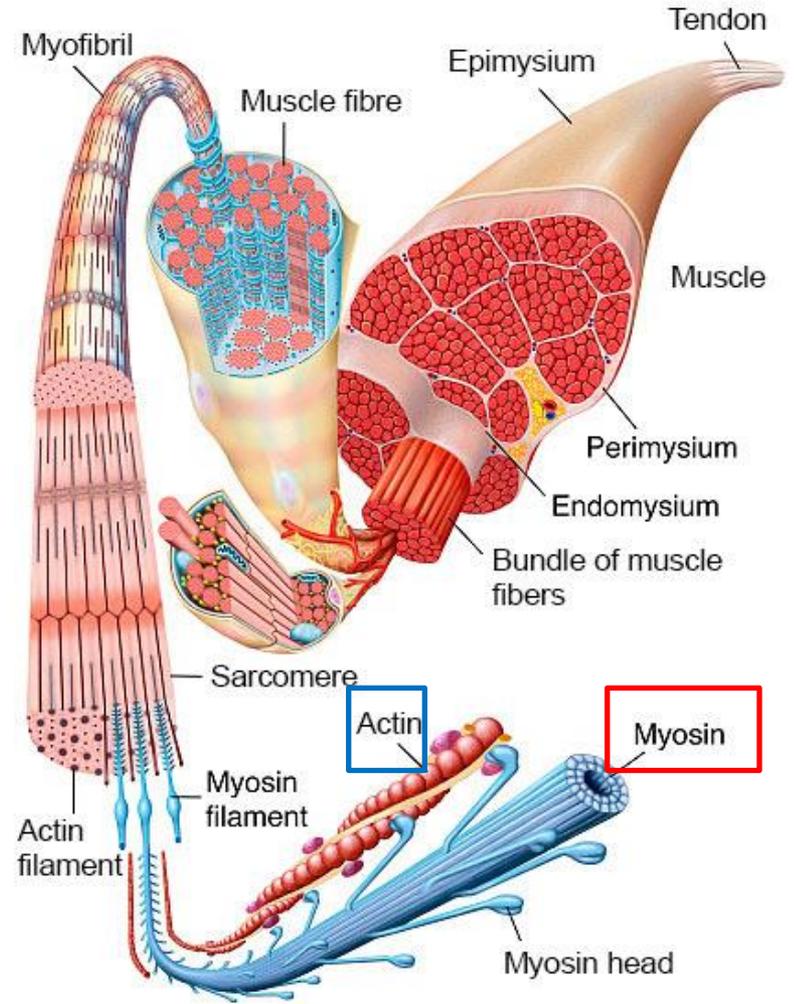
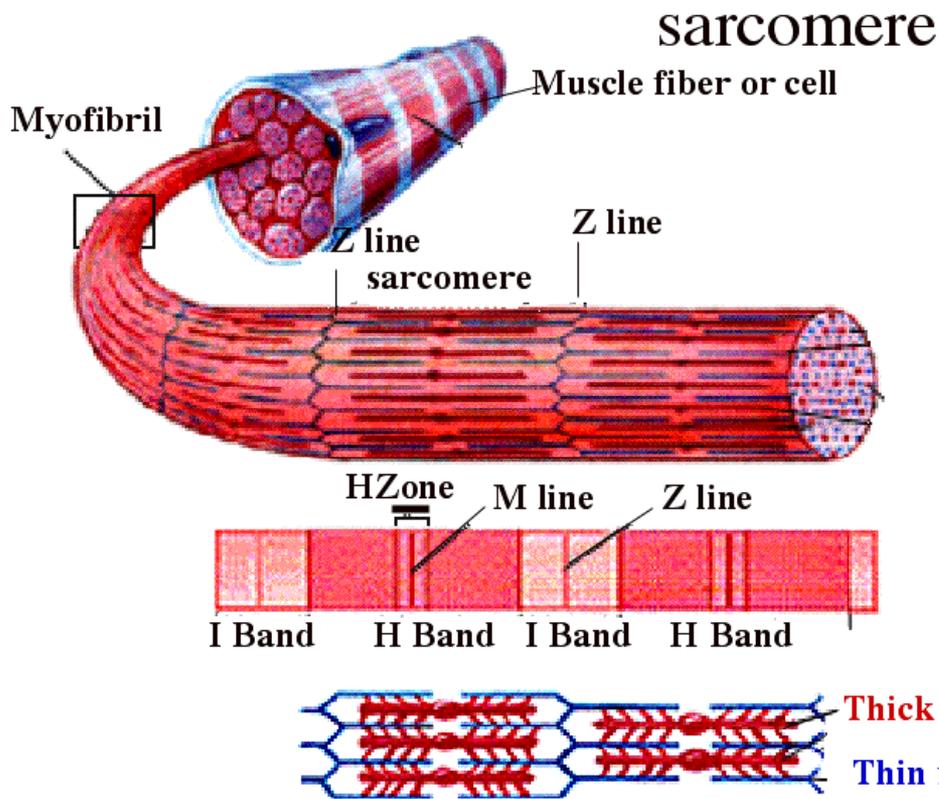


Vertebrata

- Built muscles along skeleton

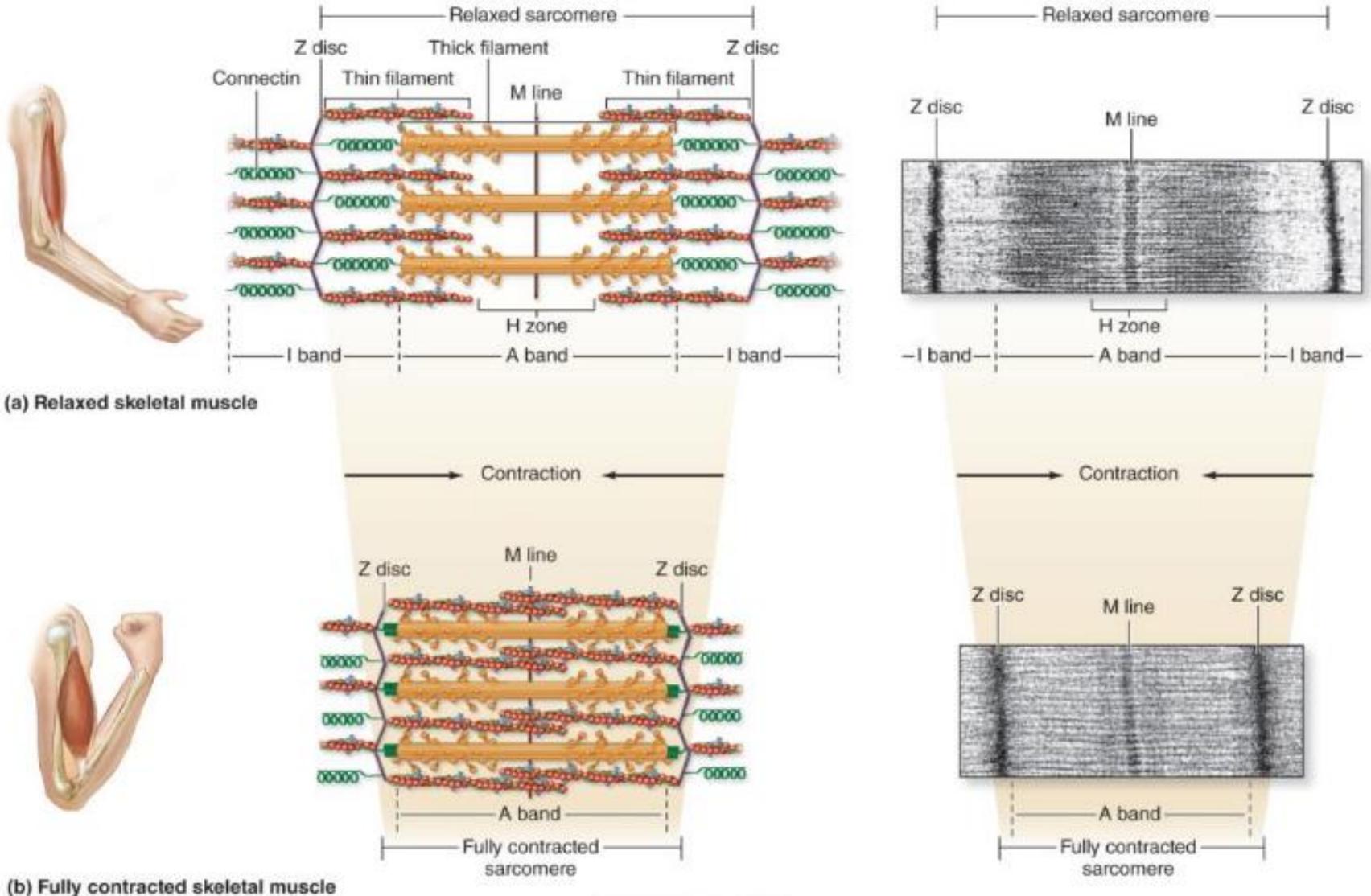


Scheme



All three muscle tissues have some properties in common; they all exhibit a **quality called excitability** as their plasma membranes can change their electrical states (from polarized to depolarized) and send an electrical wave called an action potential along the entire length of the membrane.

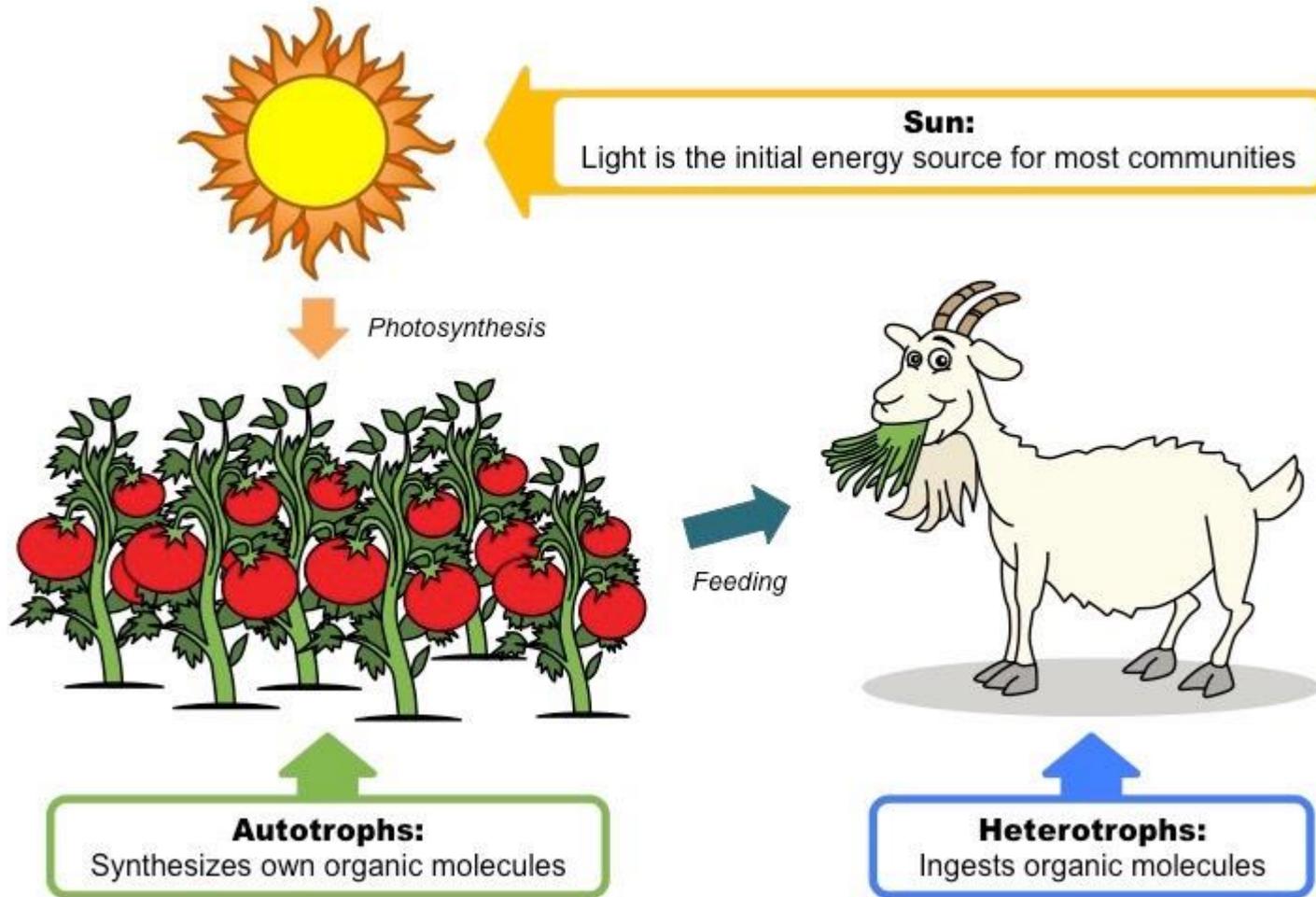
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(a) Relaxed skeletal muscle

(b) Fully contracted skeletal muscle

Digestive system



food:

any substance consumed to provide nutritional support for an organism (energy, maintenance)

Accordin to food type:



► carnivora



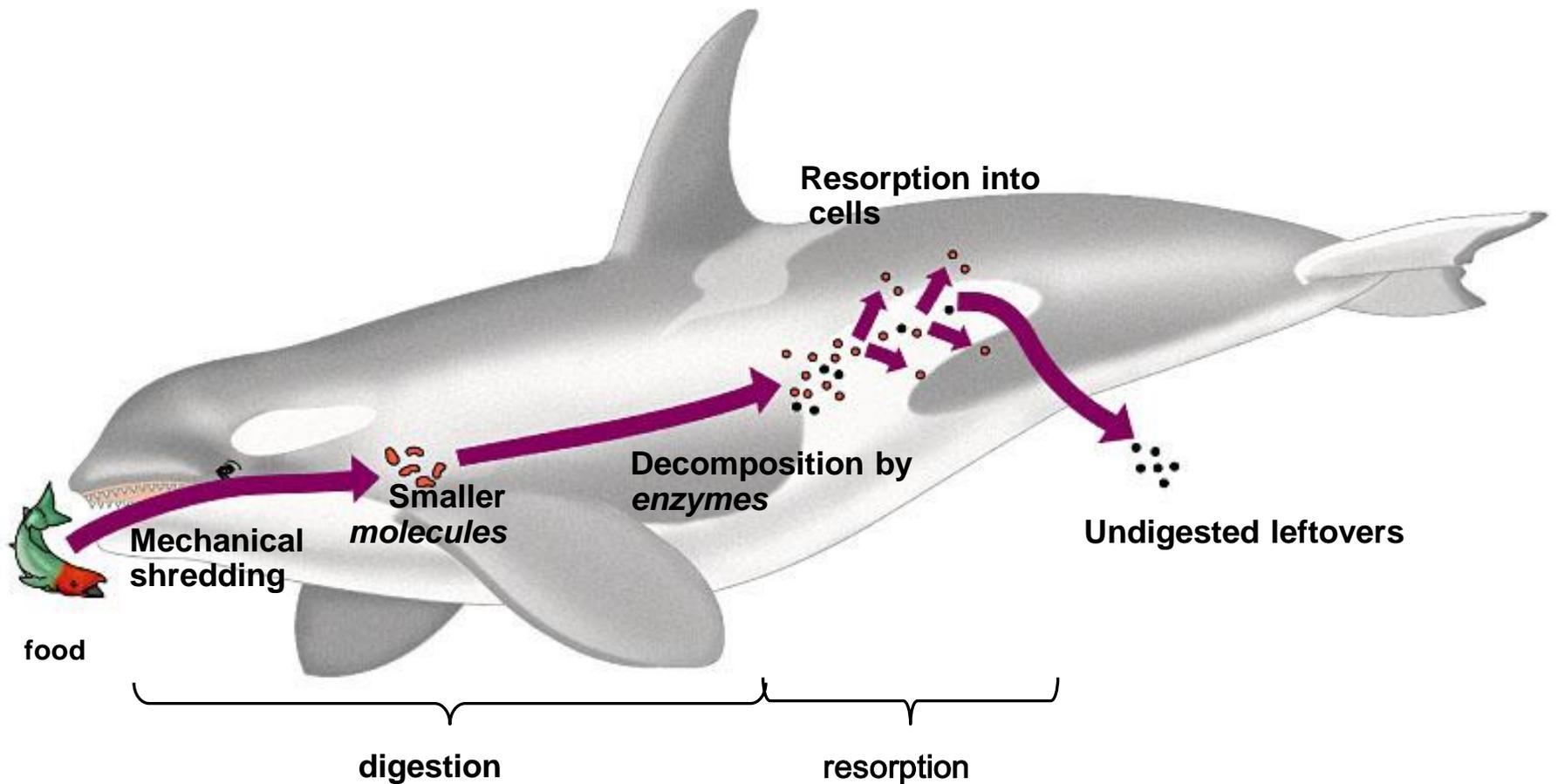
► herbivora



► omnivora



Digestion is the breakdown of large insoluble food molecules into small water-soluble food molecules so that they can be absorbed into the watery blood plasma



DIGESTION helped with enzymes

proteins → amino acids

carbohydrates → monosaccharides

lipids → fatty acids + glycerol

- Symbionts (bacteria, algae, fungi, protists) – help with digestion



Bacteria within protist within termite help digest celluloses

➤ Digestion can happen:

- **within the cell = intracellular**

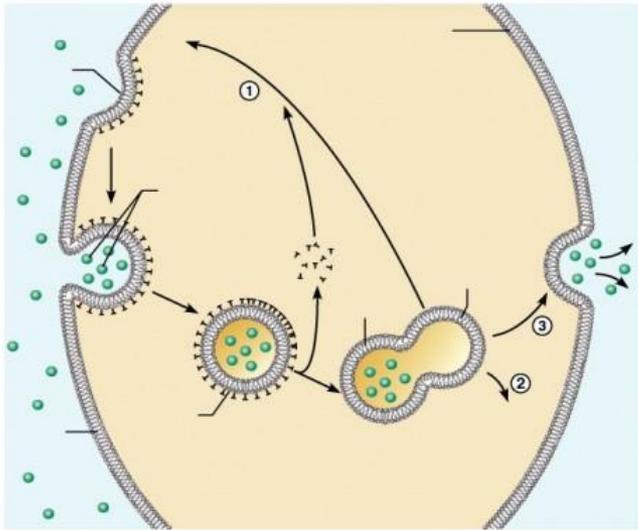
- small particles

- Protists; in Invertebrates second part of digestion

- **outside the cell (within the digestive tube) = extracellular**

- Majority of animals

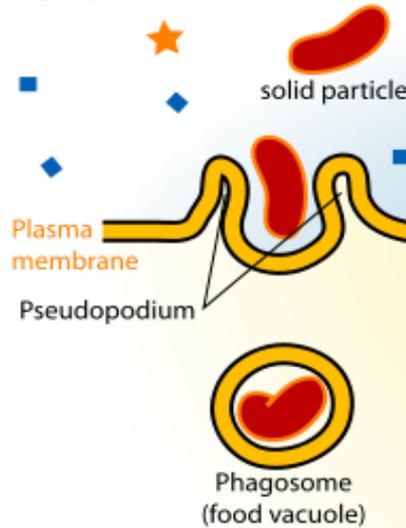
- **ENDOCYTOSIS** particles enter the cell (pinocytosis - fluids / phagocytosis - solids)
- **EGZOCYTOSIS** – undigested particles out of the cell



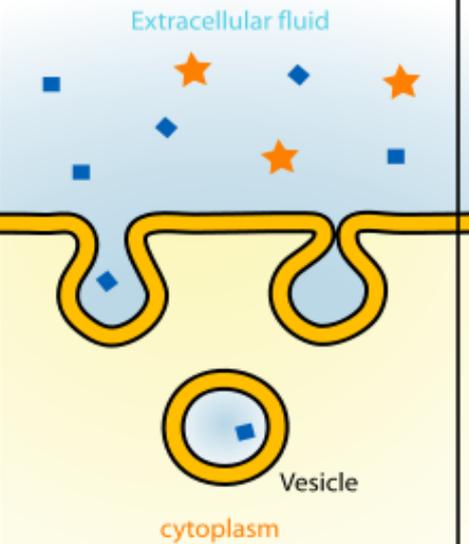
(a)
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Endocytosis

Phagocytosis



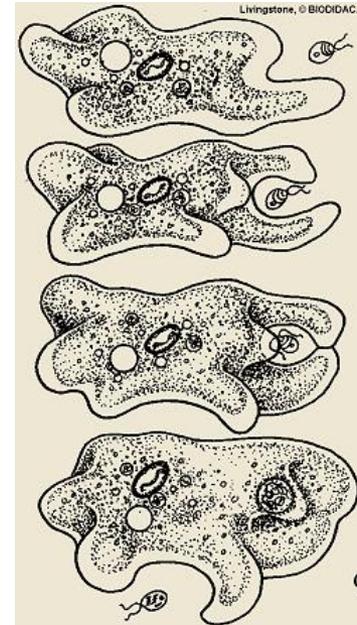
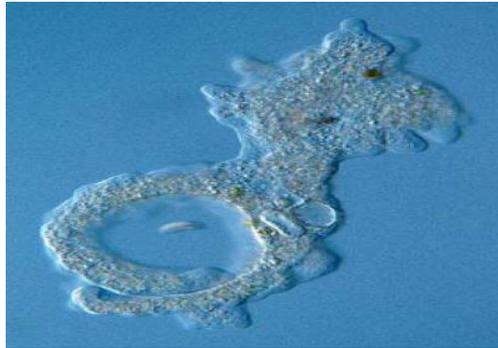
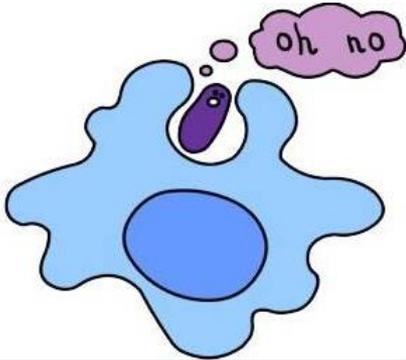
Pinocytosis



Digestive systems in different animal taxa:

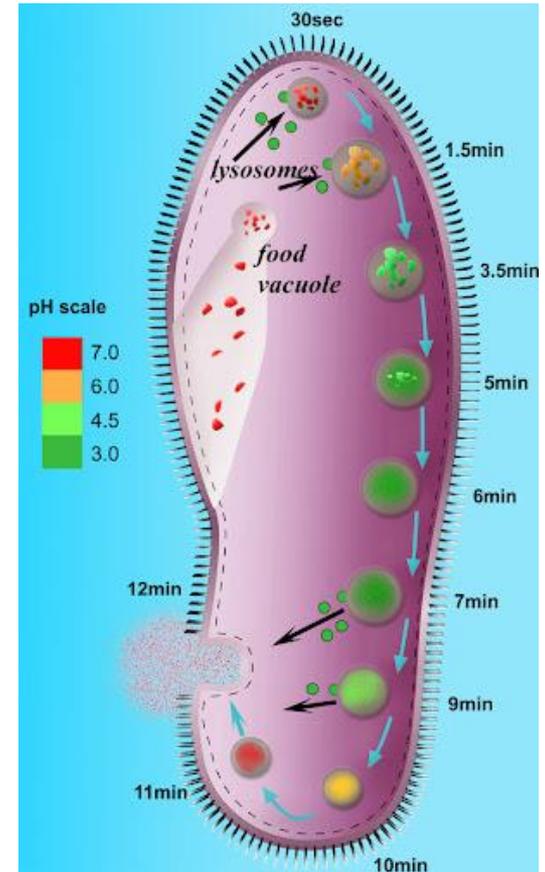
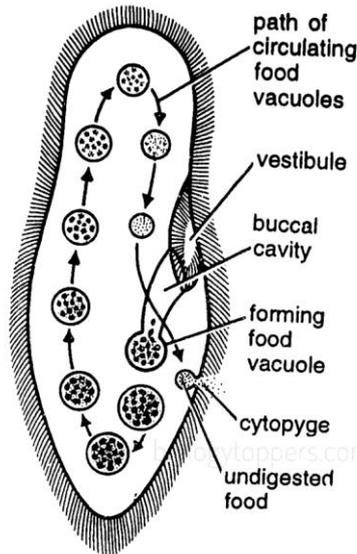
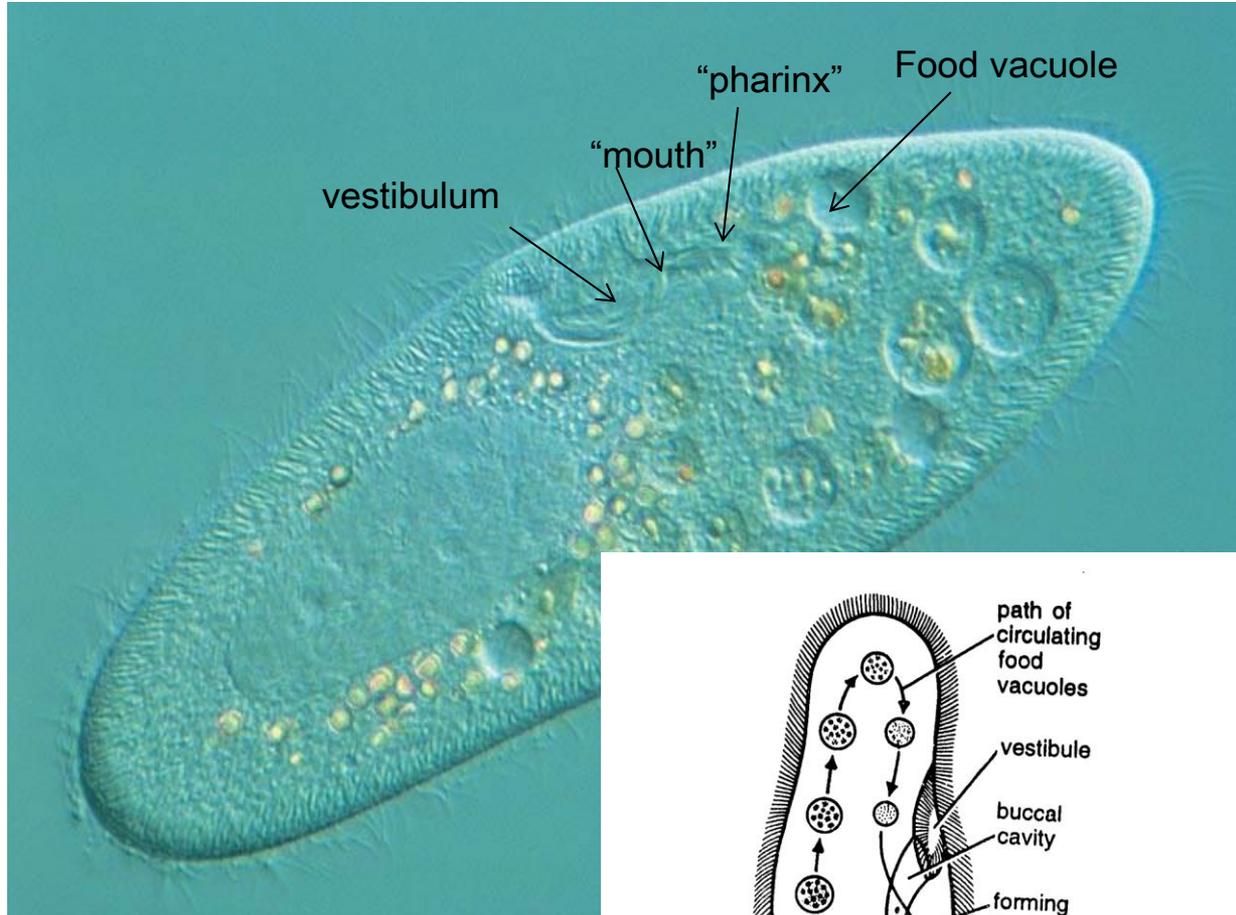
Protists

- **Permeation** (process of molecular penetration of gases, vapours or fluids through the material membrane of an organism)
- **Endocytosis** (phagocytosis, pinocytosis)



▸ Protists with pellicle

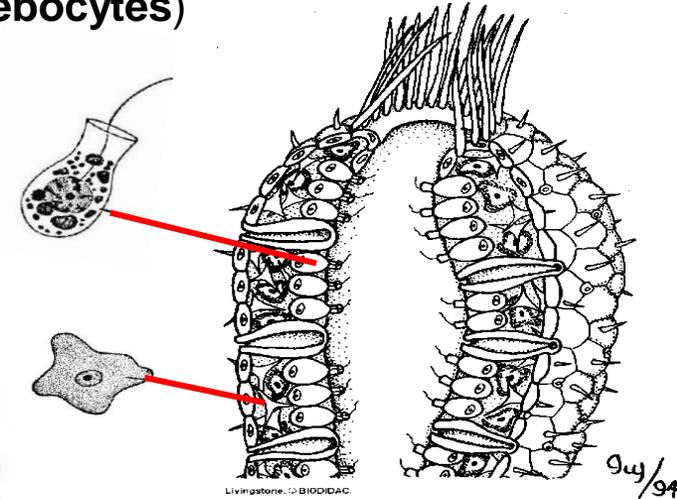
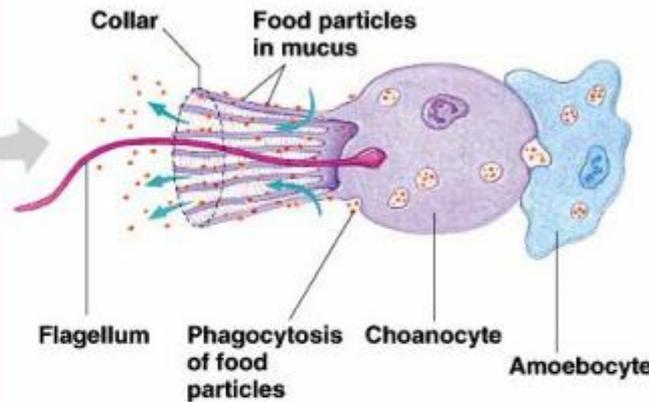
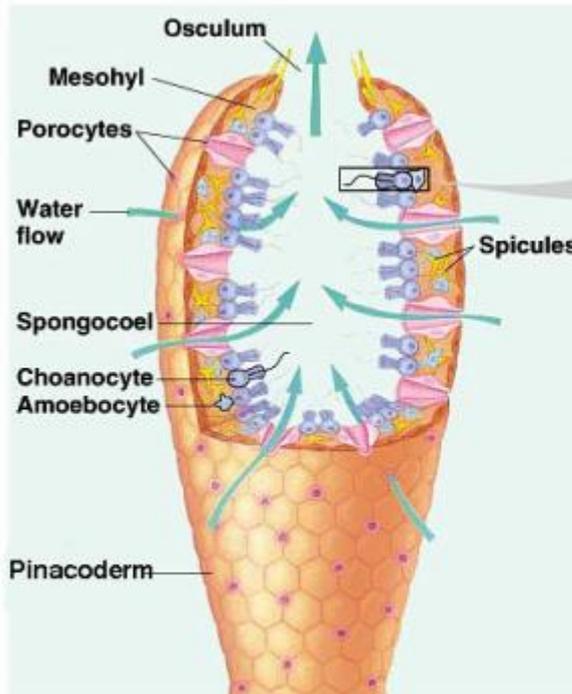
„mouth” – „pharynx” - food vacuoles + enzymes – digestion (circulated through the cell/animal) – undigested through cytoproct (cytopyge) out





Phylum PORIFERA (SPONGIA)

- filter feeders
- two cell types digest food particles (**choanocytes and amoebocytes**)
- **intracellular digestion**

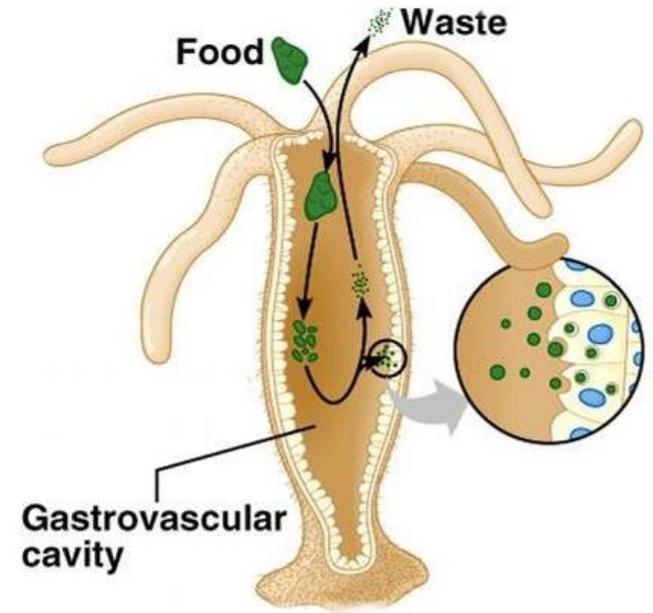
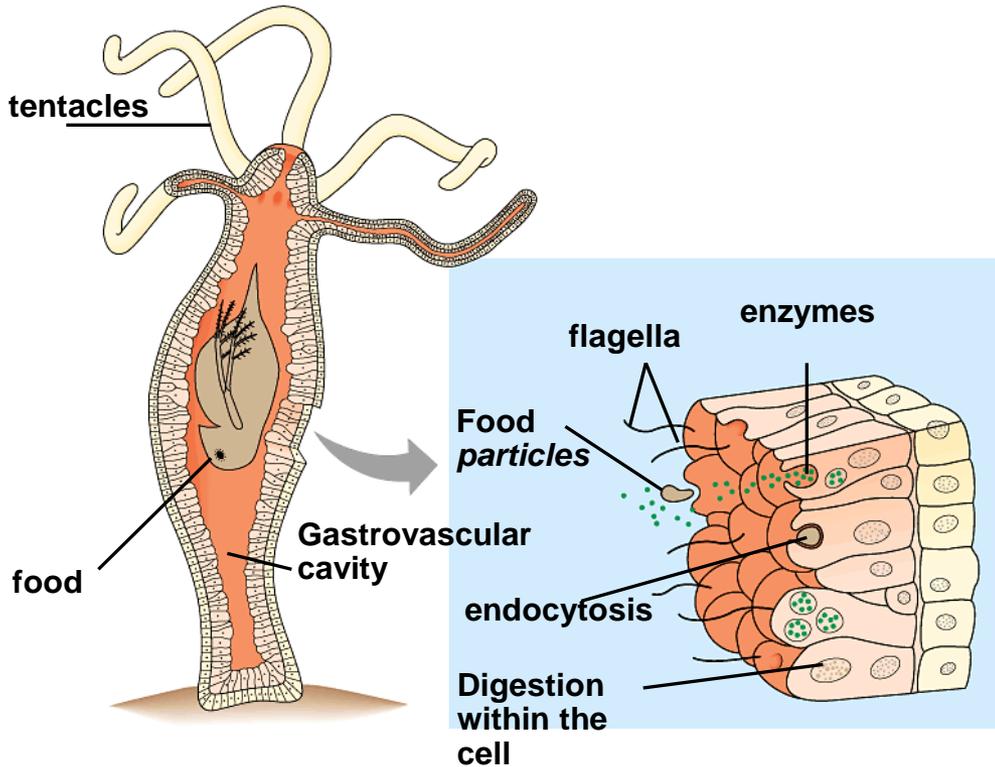
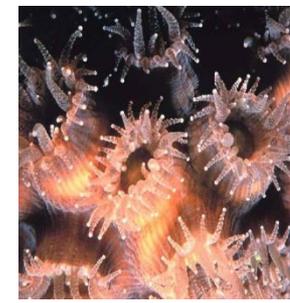


Simple sponge (left) and enhanced view of a choanocyte (right).

Phylum Cnidaria (Coelenterates) and Platyhelminthes (flatworms)

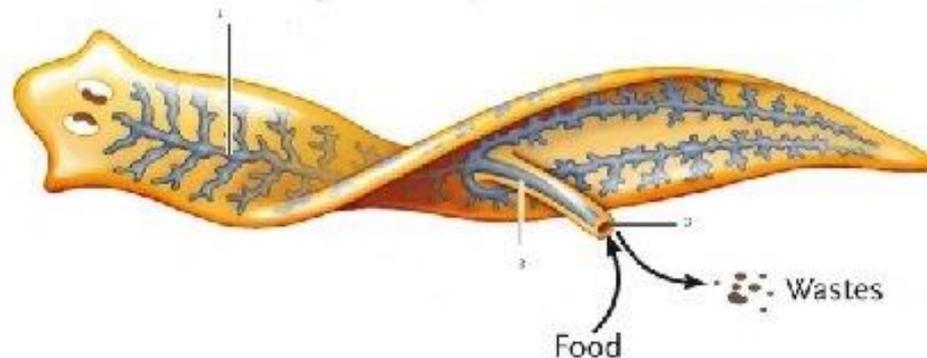
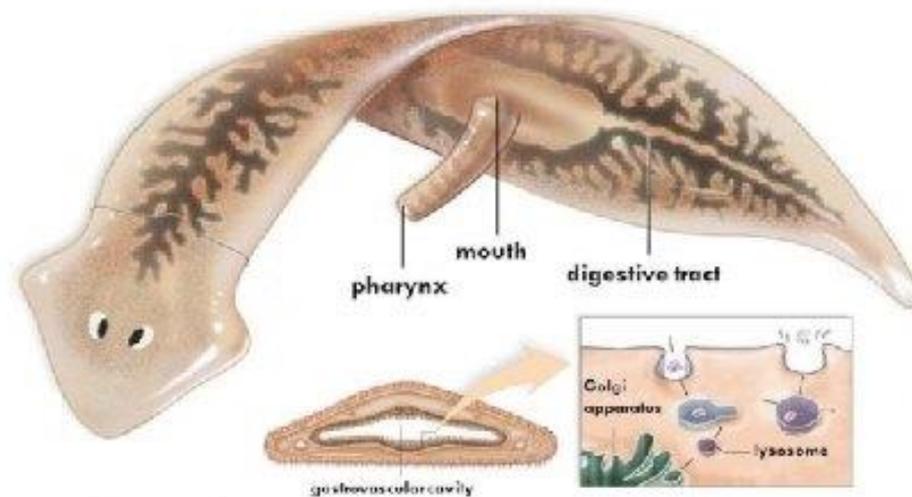
- „blind gut" or "blind sac", since food enters and waste exits through the same orifice

-extracellular & intracellular (gastrovascular cavity is the primary organ of digestion)





Phylum Platyhelminthes - Flatworms



Digestion:

- Mouth, Pharynx, digestive tract
- **Incomplete** digestive tract which means no **anus**
- Feed on algae, dead organisms, blood, etc.

Complete digestive tract

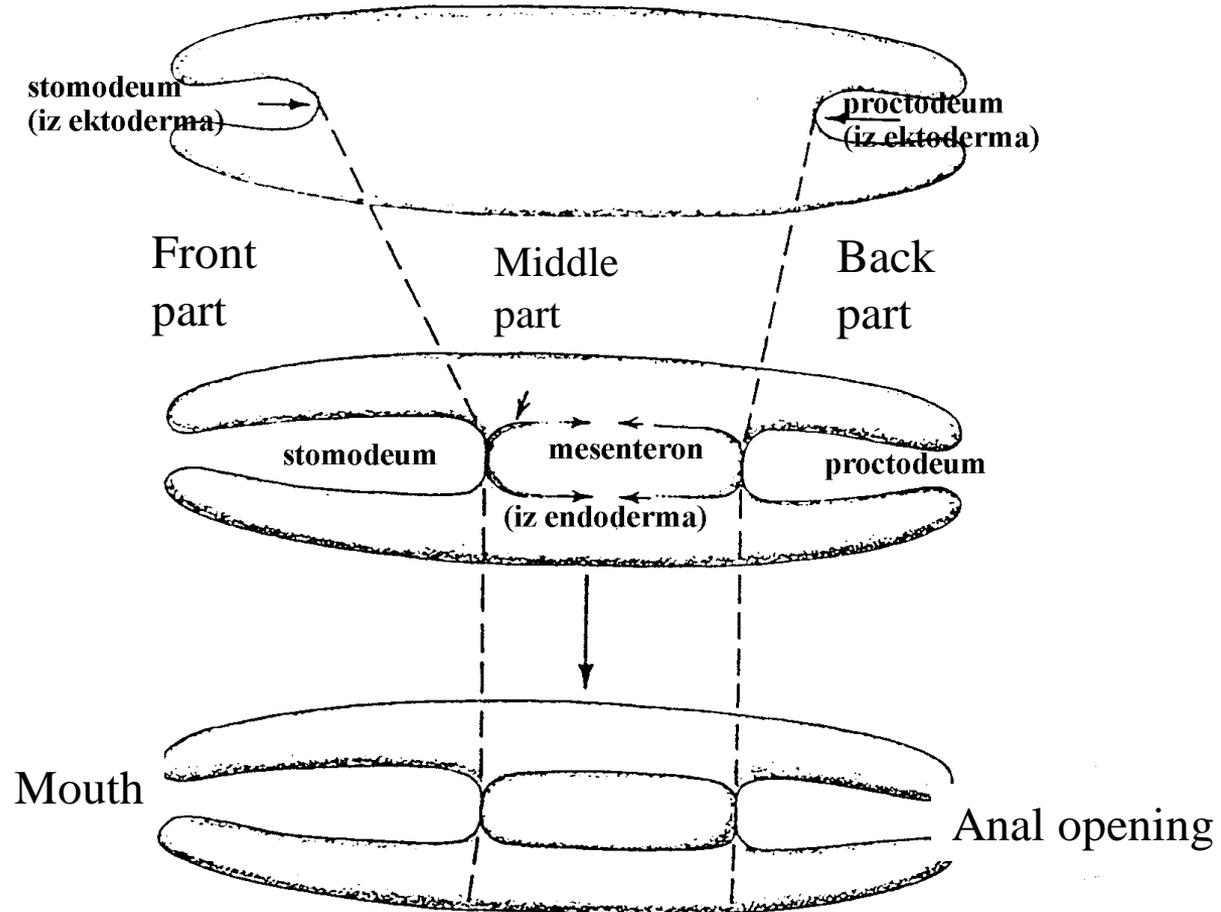
- continuous food flow

BASIC SCHEME

I *stomodeum*: ectodermal

II *mesenteron*: endodermal
(digestion)

III *proctodeum*: ectodermal

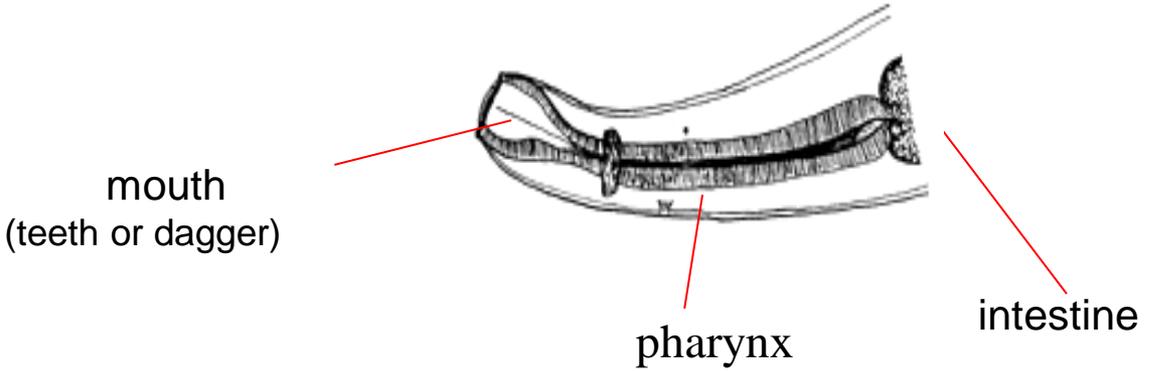
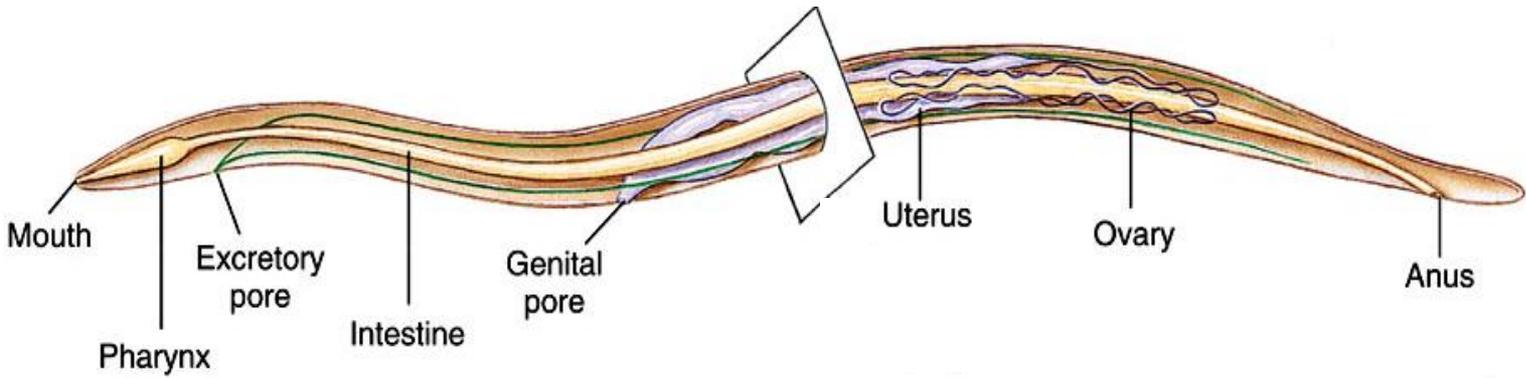


Phylum Nematoda (roundworms)

- Complete digestion tract
- Extracellular digestion



Ascaris



- additional parts – help digestion being more efficient

- food storage sacs

- stomach

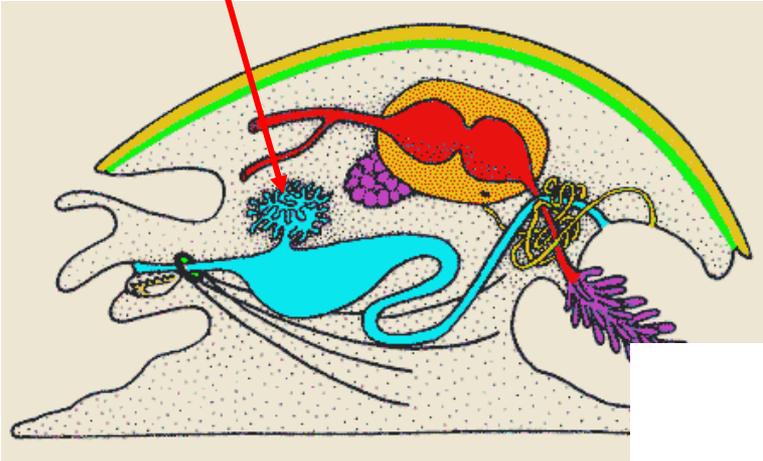
- additional glands

- intestinal villi

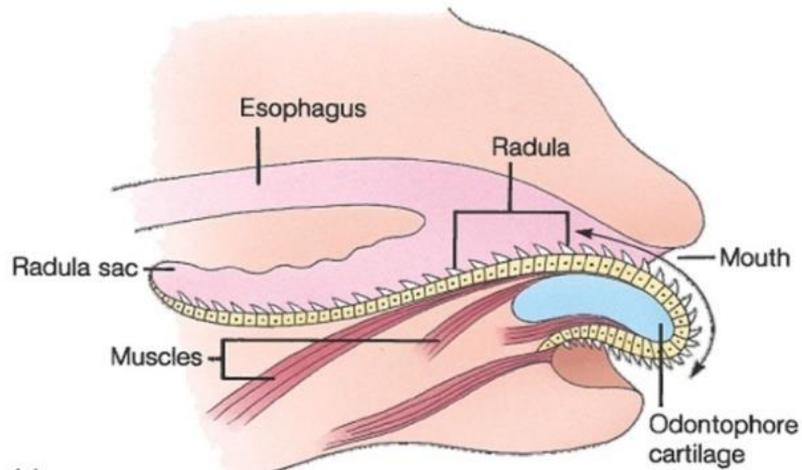
Phylum Mollusca

- complete digestive tract
- digestive gland

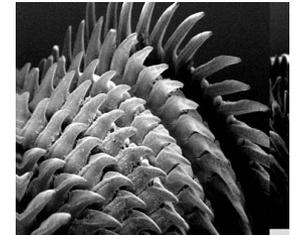
Digestive gland



- **radula** – teeth for grazing



(a)



Bivalves (and some snails)

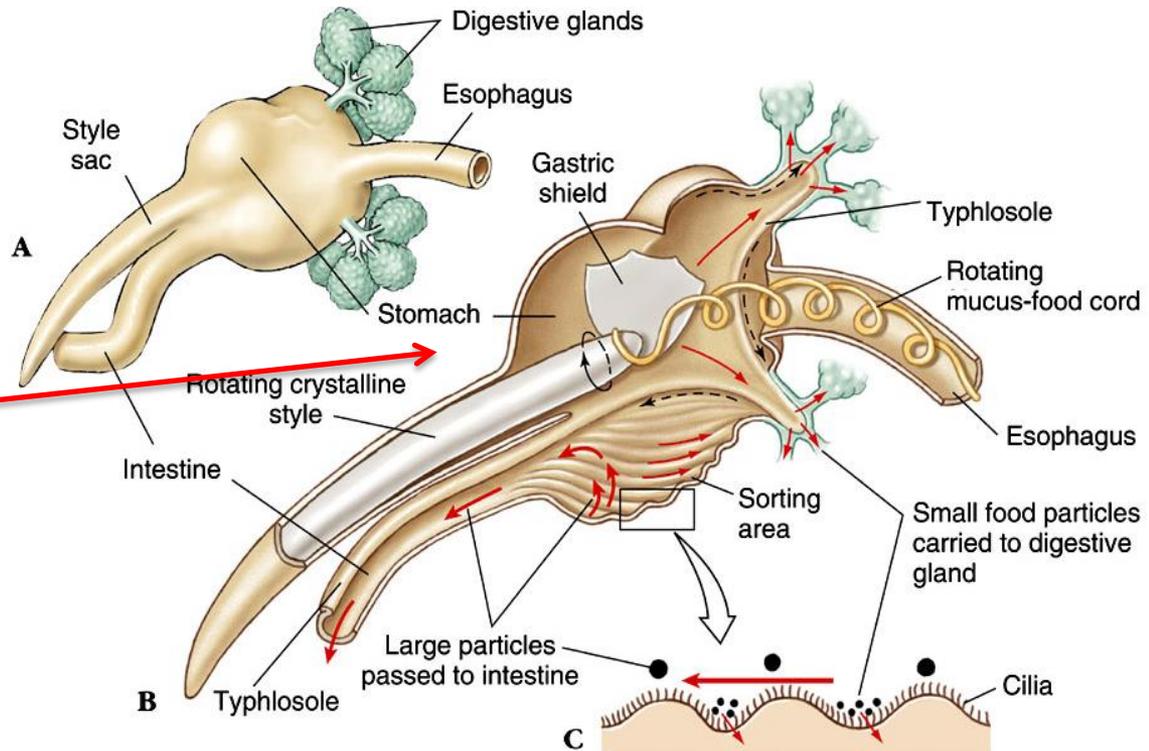
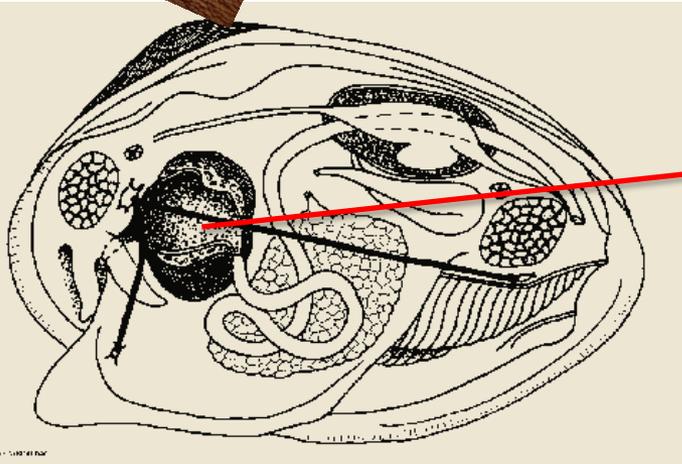
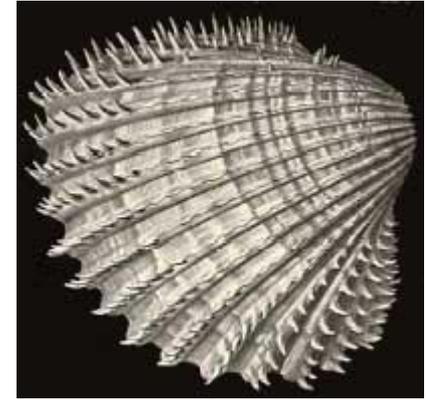
No radula

Esophagus – mucus-food cord pull food into stomach

Stomach – gastric shield + rotating crystalline style – enzymes + mucus

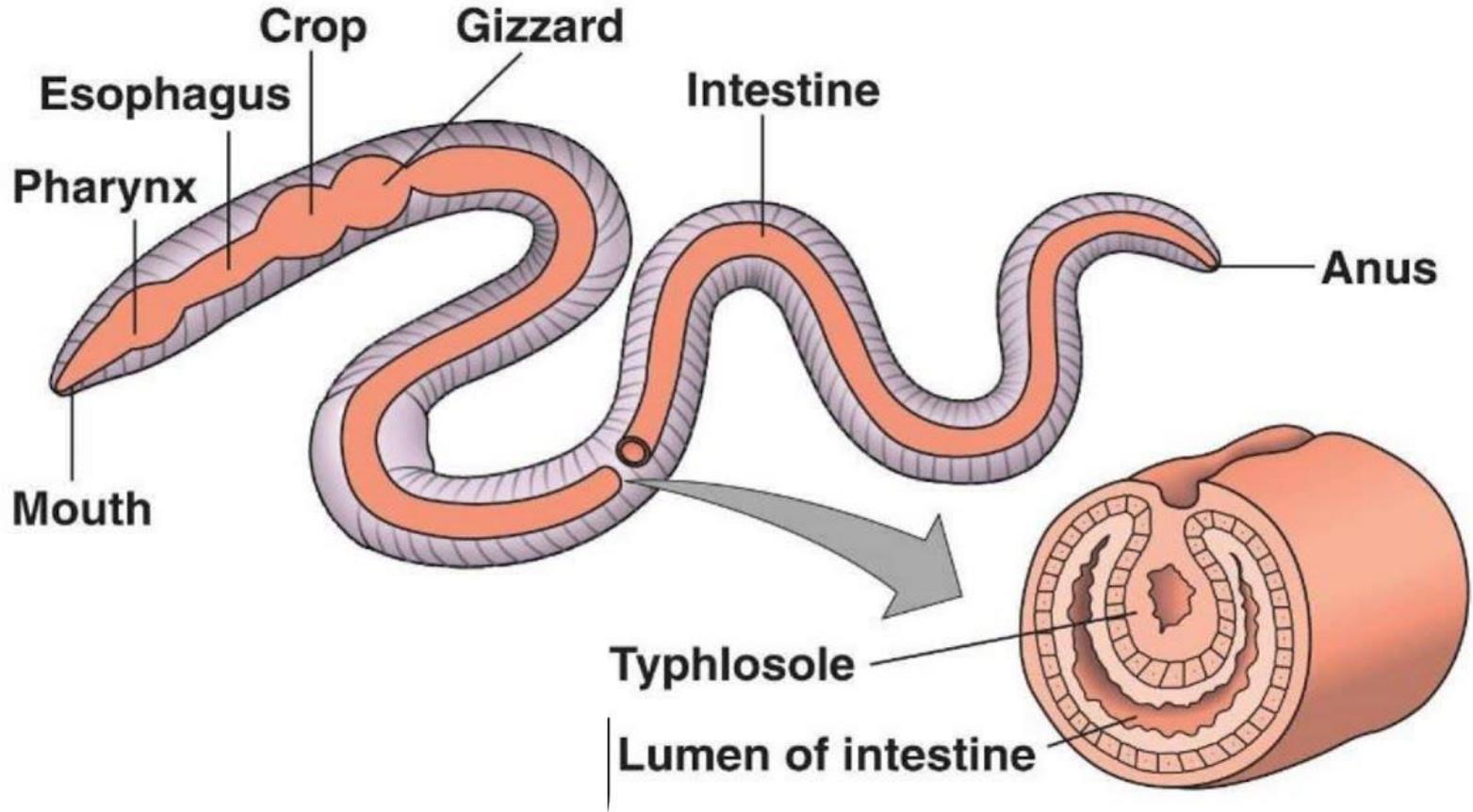
Digestive glands – small particles

Intestine – bigger particles (digestion)



Phylum Annelida

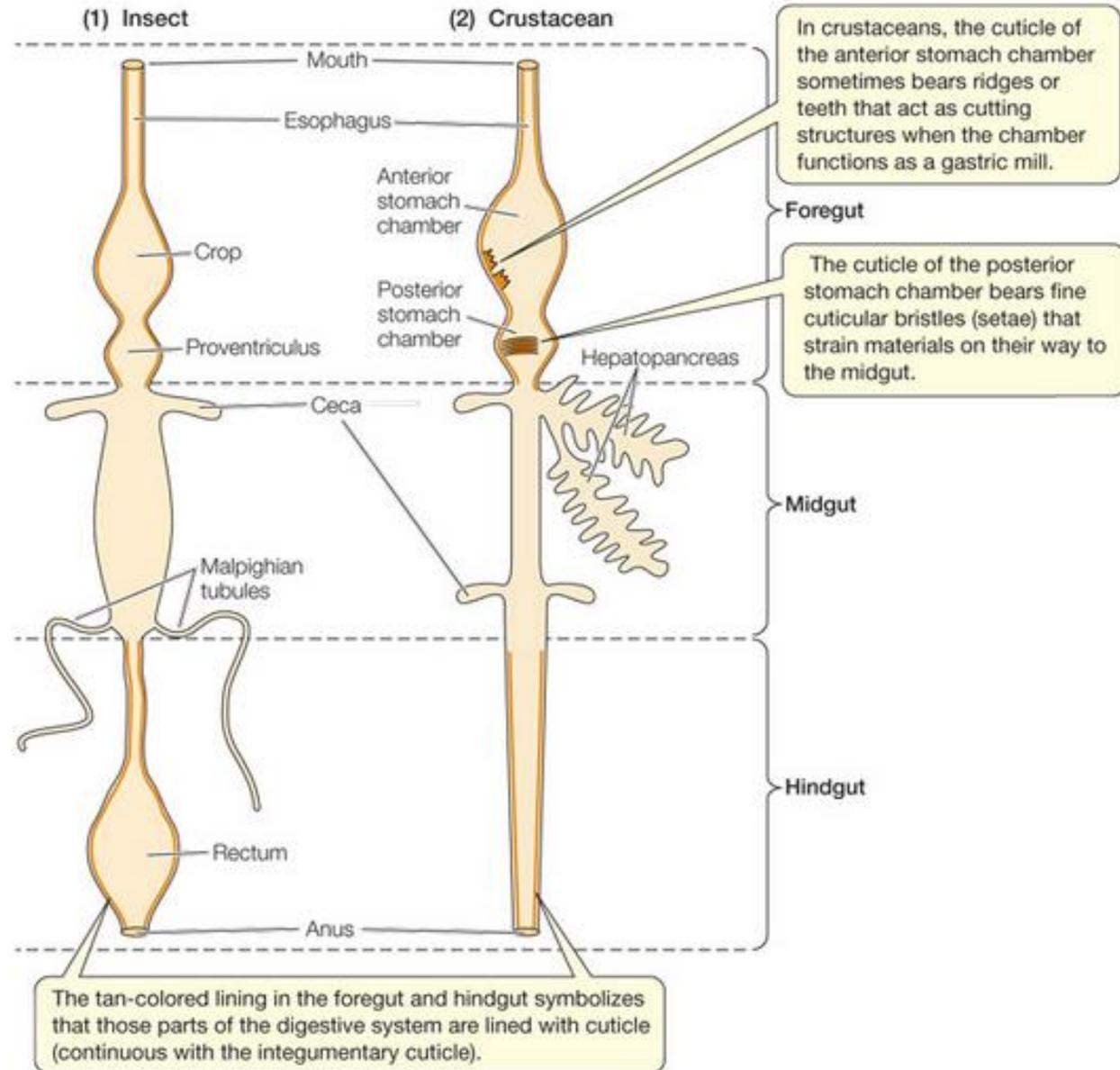
- complete digestive tract
- stomodeum (mouth, esophagus, crop, gizzard)
- mezenteron, - digestion
- proctodeum



(a) Earthworm

Phylum Arthropoda

- complete digestive tract
- stomodeum (mouth, esophagus, crop/stomach)
- mezenteron, - digestion (glands)
- proctodeum

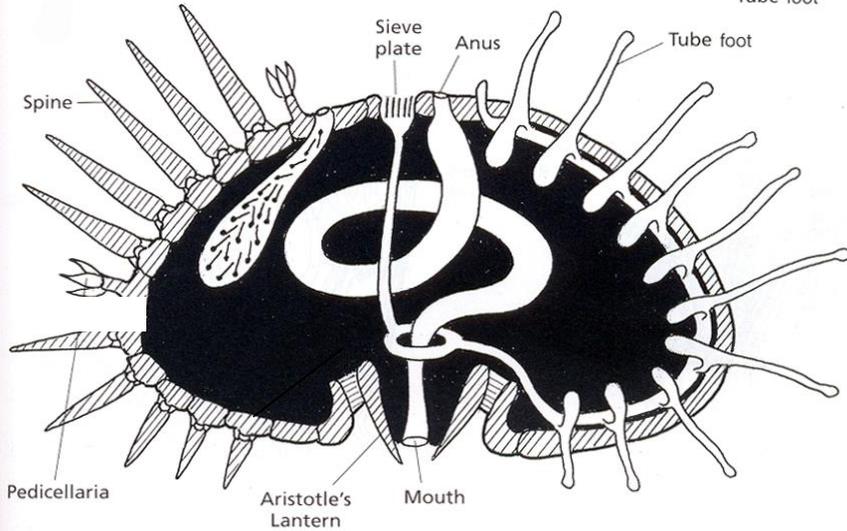
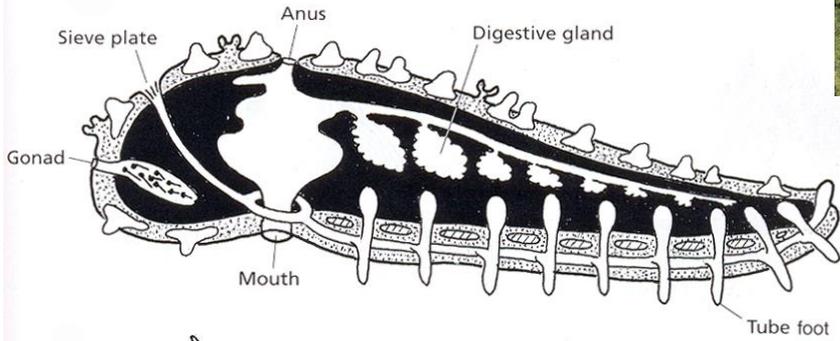


Phylum Echinodermata

- Complete digestion tract

Digestion out of body

Class Asterozoidea

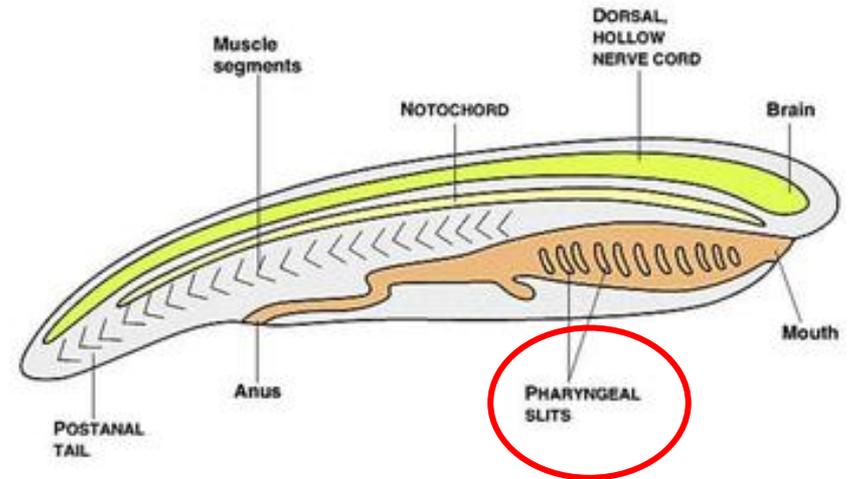
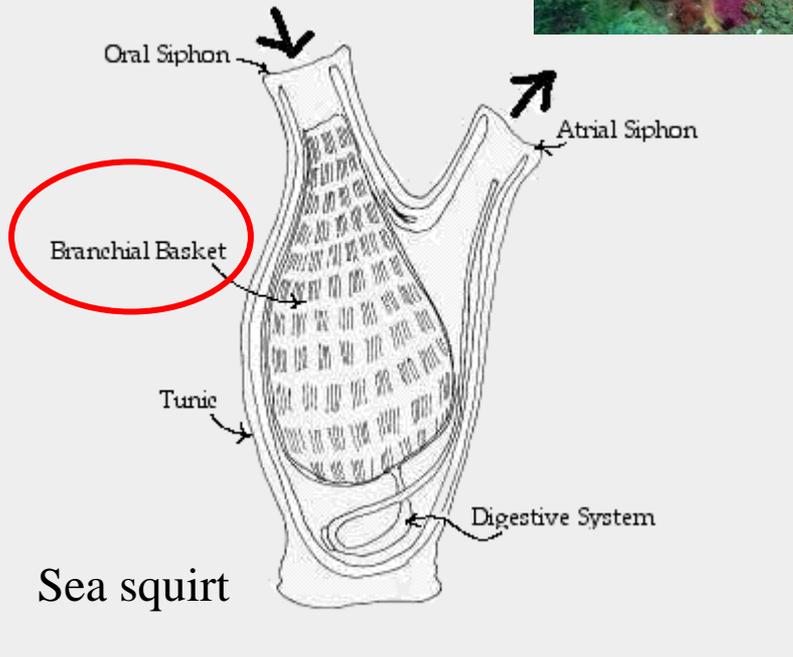


Class Echinozoidea

Phylum Chordata – subphyla Tunicata & Acrania)

- Digestive tract of endodermal origin

- branchial basket/pharyngeal slits /pharynx with gill slits – feeding and breathing



Little lancelet

Subphylum Vertebrata

☛ digestive tract – endodermal

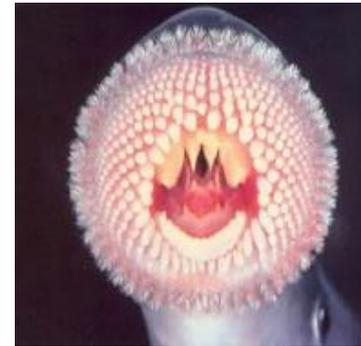
mouth › pharynx › esophagus › stomach › small & large intestine › anal opening (bony fish and mammals that don't lay eggs) or cloaca

- **mouth: upper and lower jaw** (except Cyclostomata), birds – beak; salivary glands, tongue, teeth

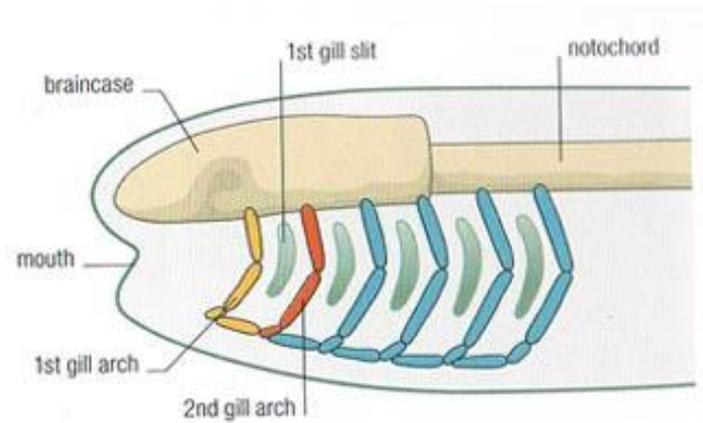
Class Cyclostomata (lampreys)

No jaws

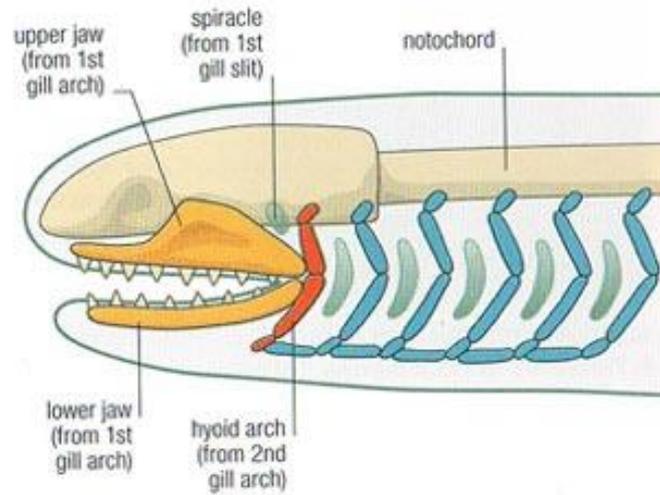
- instead cartilage ring with „teeth”



Jaw development - from gill arches



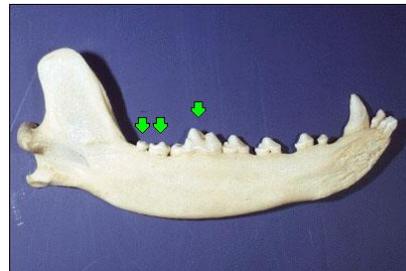
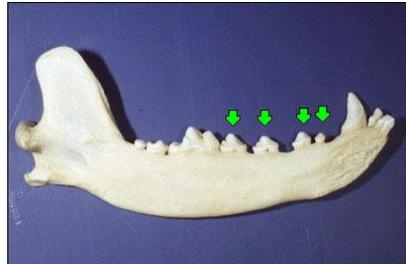
AGNATHOUS (JAWLESS) VERTEBRATE



GNATHOSTOME (JAWED) VERTEBRATE

teeth

- homodont all the same
- heterodont different shape and role
 - INCISIVES
 - CANINES
 - PRAEMOLARES
 - MOLARES



RODENTNS



INSECTIVORS



HERBIVOR

CARNIVOR

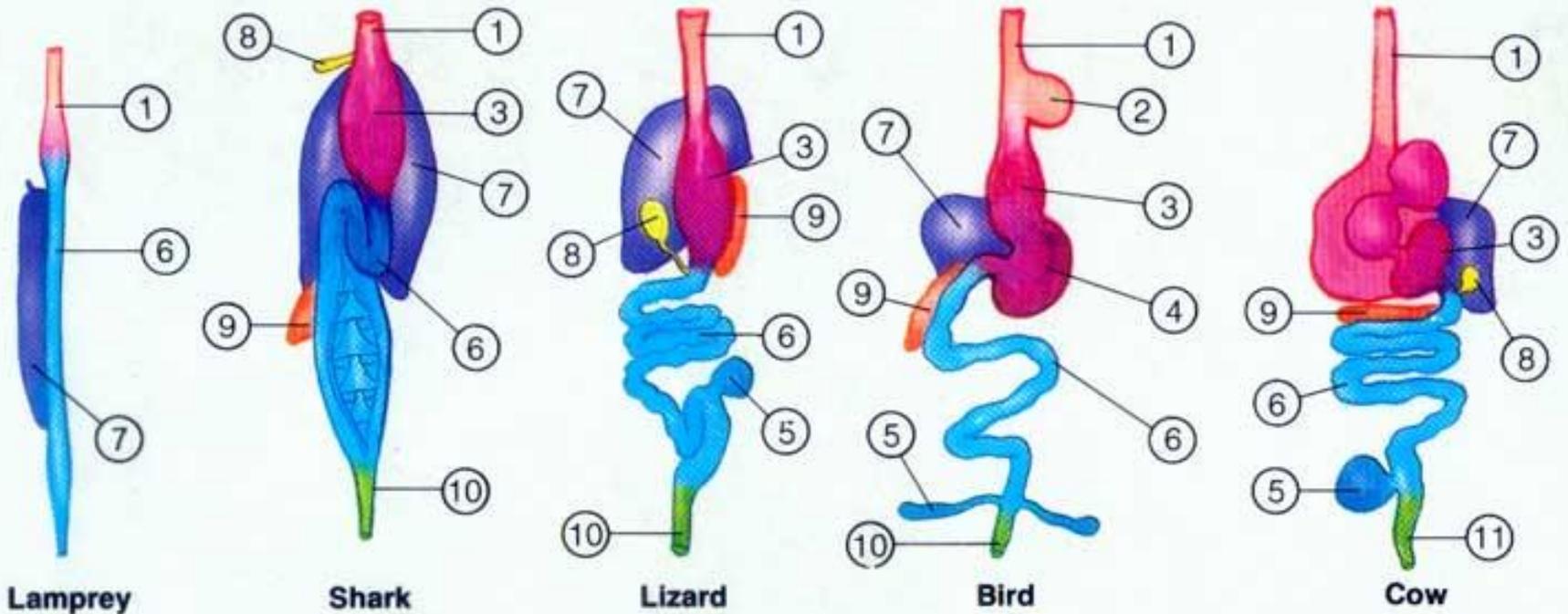


OMNIVOR



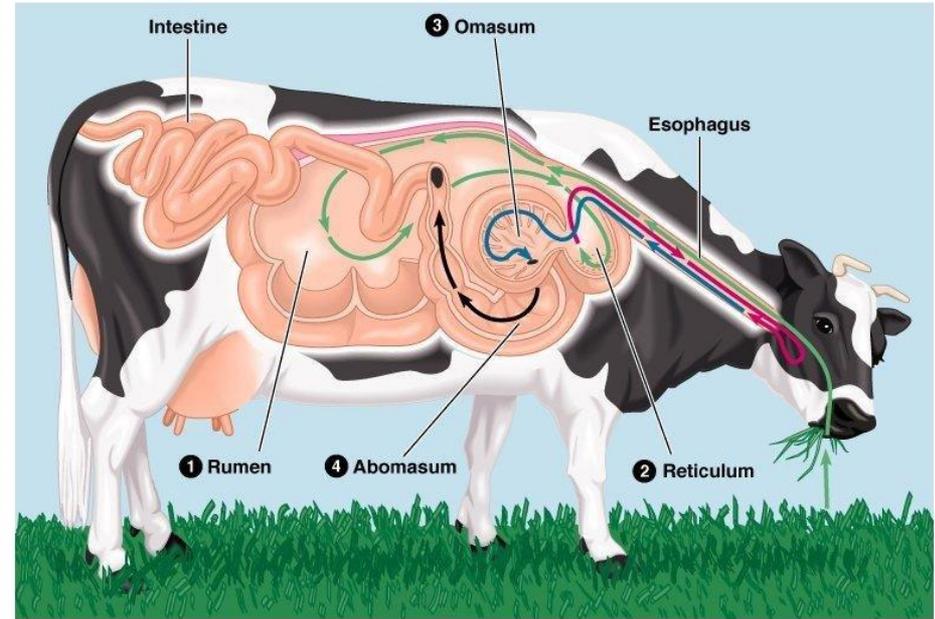
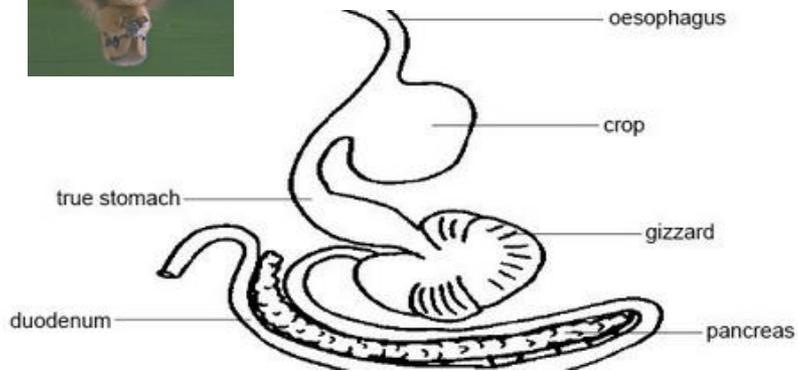
- *pharynx*
- *(o)esophagus* (birds crop – to soften food)

47. The Digestive Systems of Vertebrates



- ① Esophagus ② Crop ③ Stomach ④ Gizzard ⑤ Cecum ⑥ Intestine ⑦ Liver
 ⑧ Gallbladder ⑨ Pancreas ⑩ Cloaca ⑪ Rectum

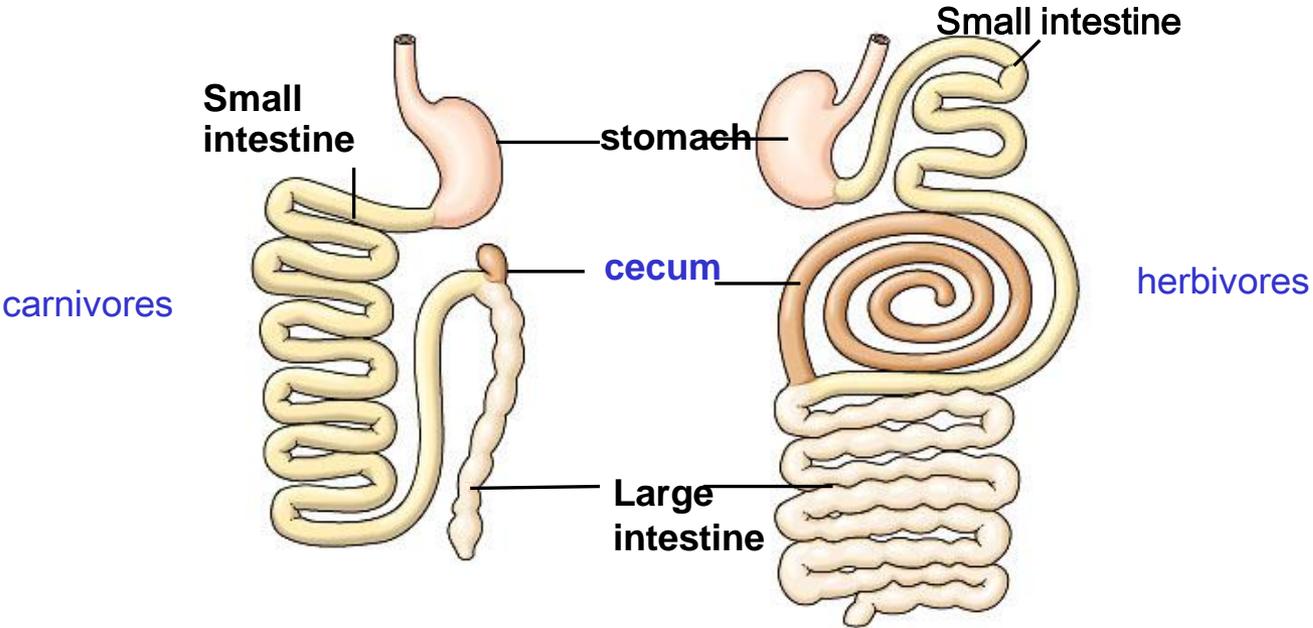
- **stomach** (*gaster*)



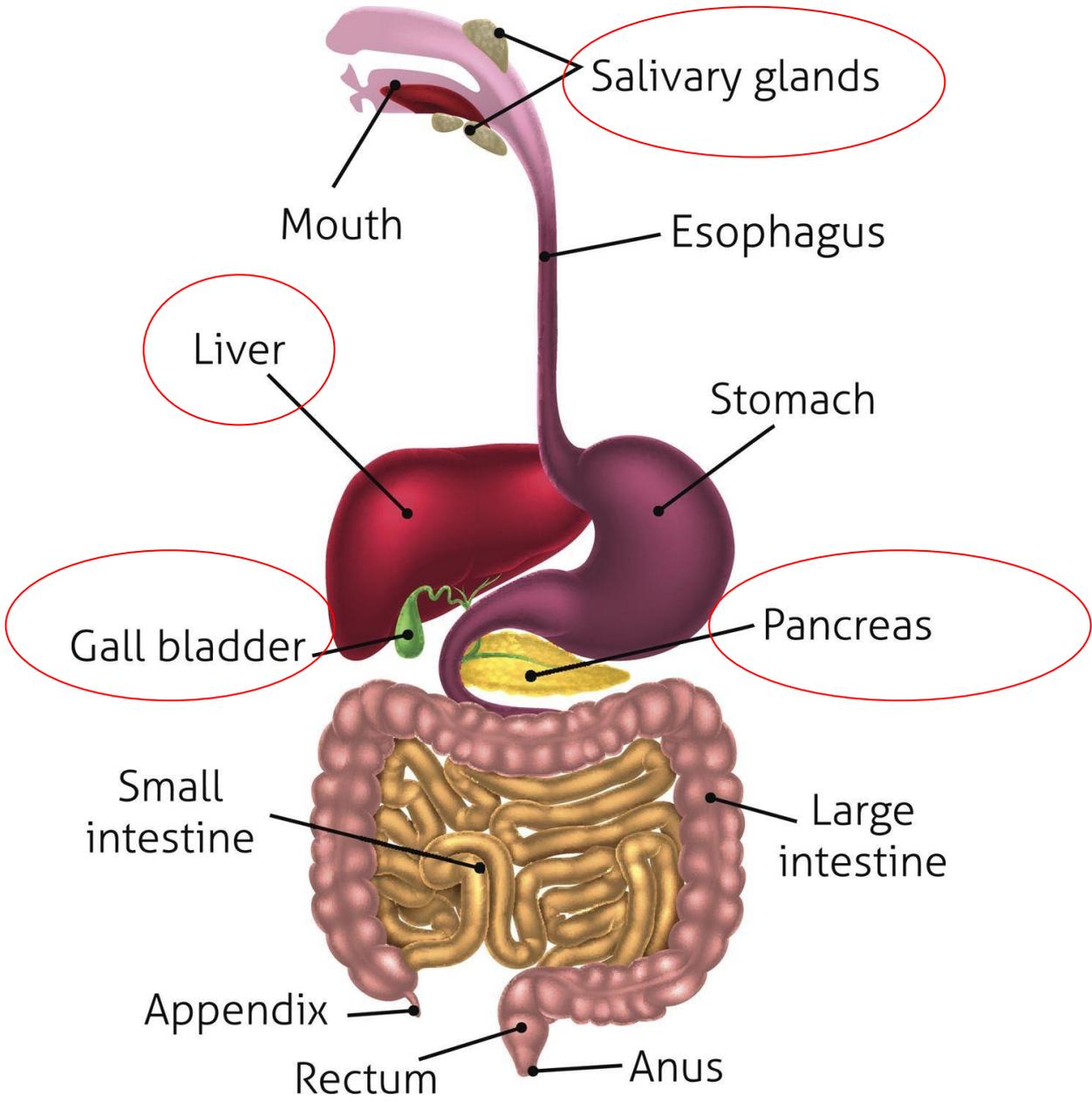
©1999 Addison Wesley Longman, Inc.

- **small intestine** - duodenum (digestive fluids from pancreas and liver),
 - numerous villi

▪ **large intestine** – anal opening (bony fish and majority of mammals) or cloaca (the rest) – **cecum** (between small and large intestines)



**Additional
organs/glands**



► **big resorption surface** - folds, villi & microvilli (mammals)

