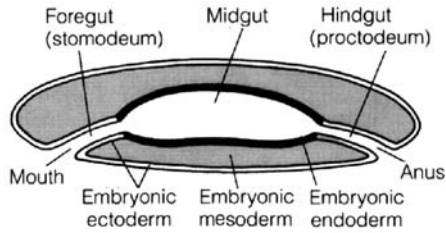
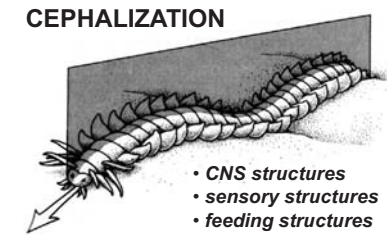
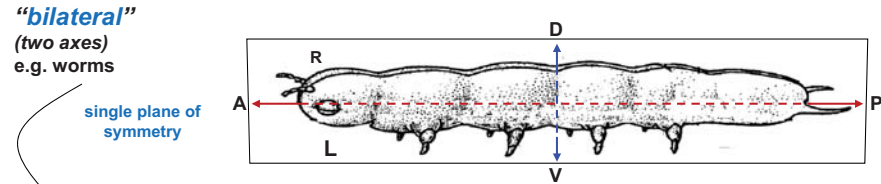
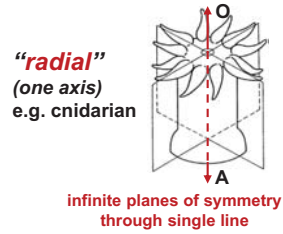
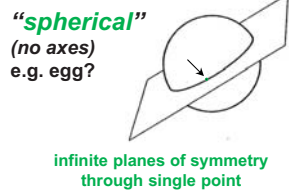
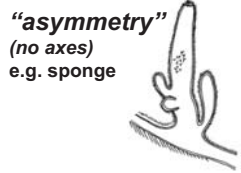
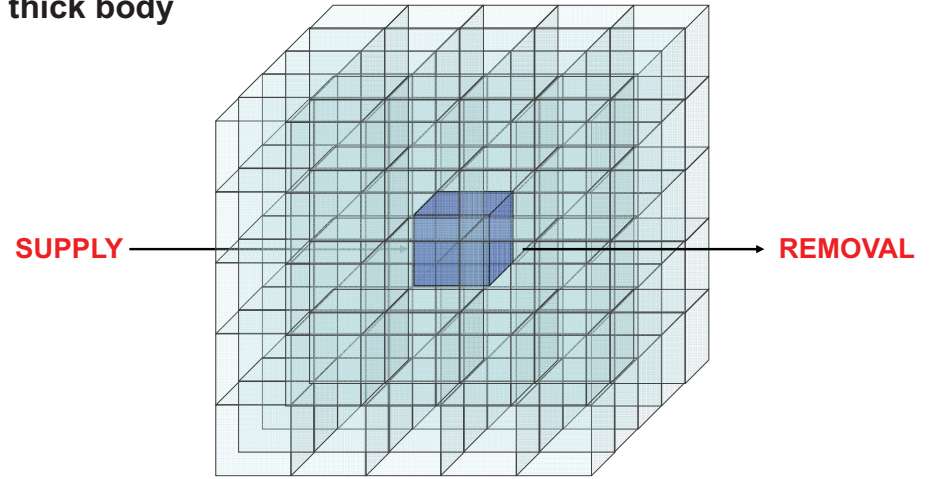


SYMMETRY and BODY AXES



Challenges to building a thick body

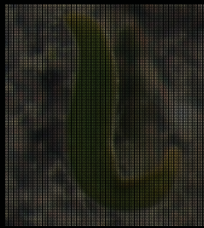
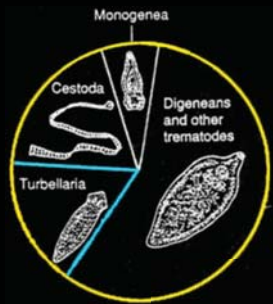


Scaling problem

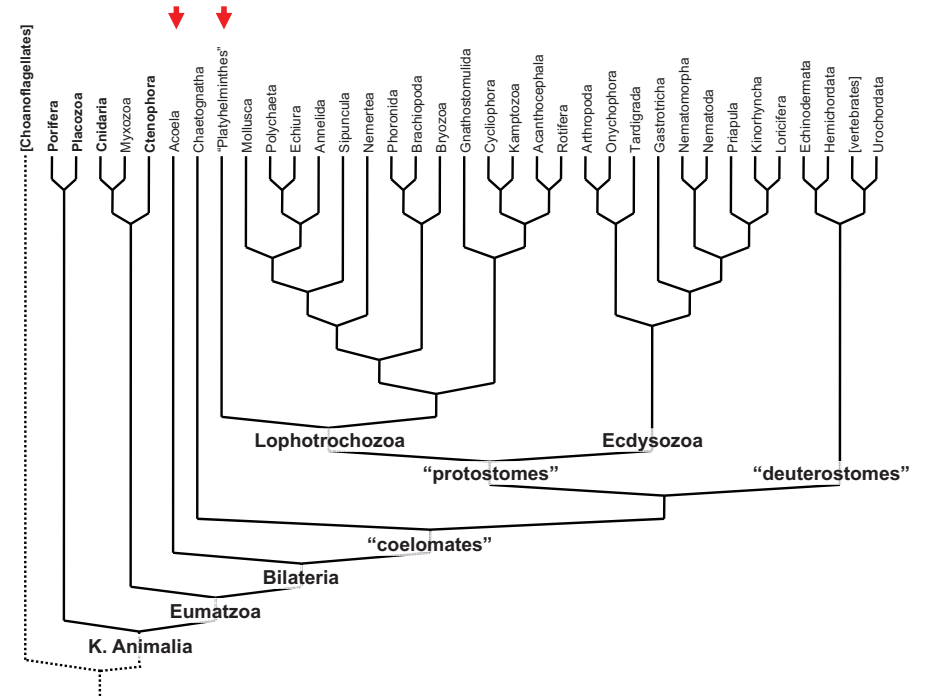
$$\frac{\text{Surface area} \propto \text{length}^2}{\text{Volume} \propto \text{length}^3}$$

Solutions?

Ph. Platyhelminthes: Cl. Turbellaria

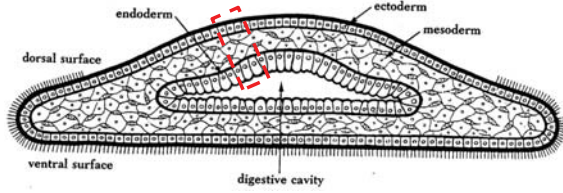


Theme: limits of diffusion, size and complexity



Ph. Platyhelminthes

3 embryonic germ layers



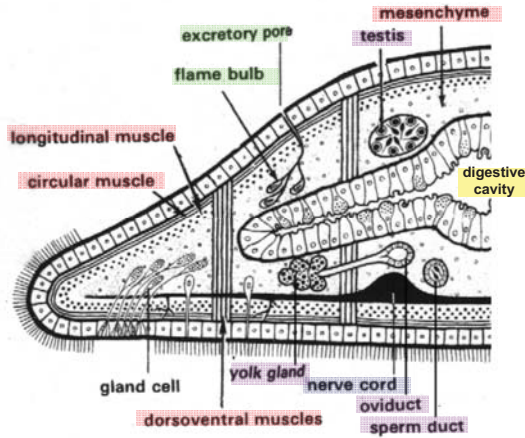
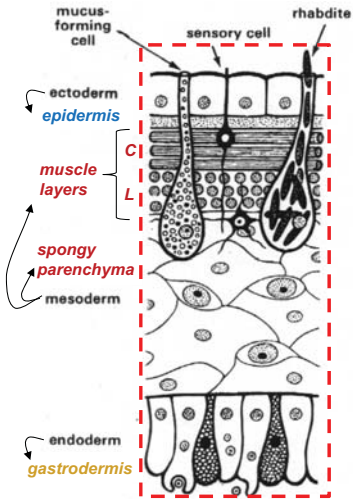
Mesoderm (muscle)

Excretory

Nervous

Reproductive

Digestive



Muscle

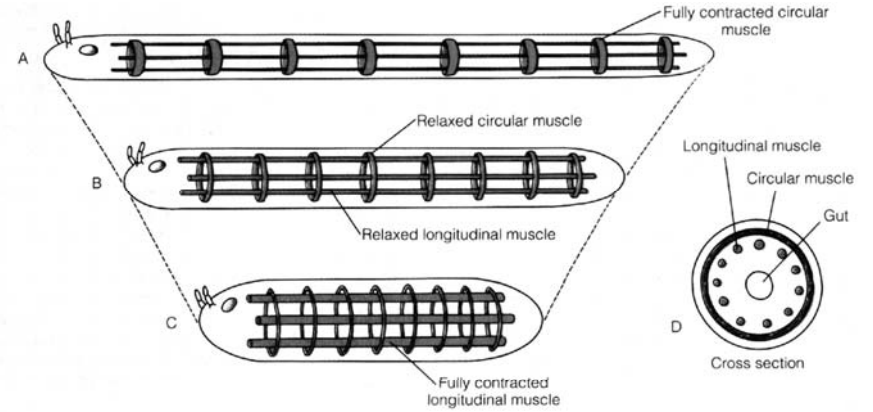
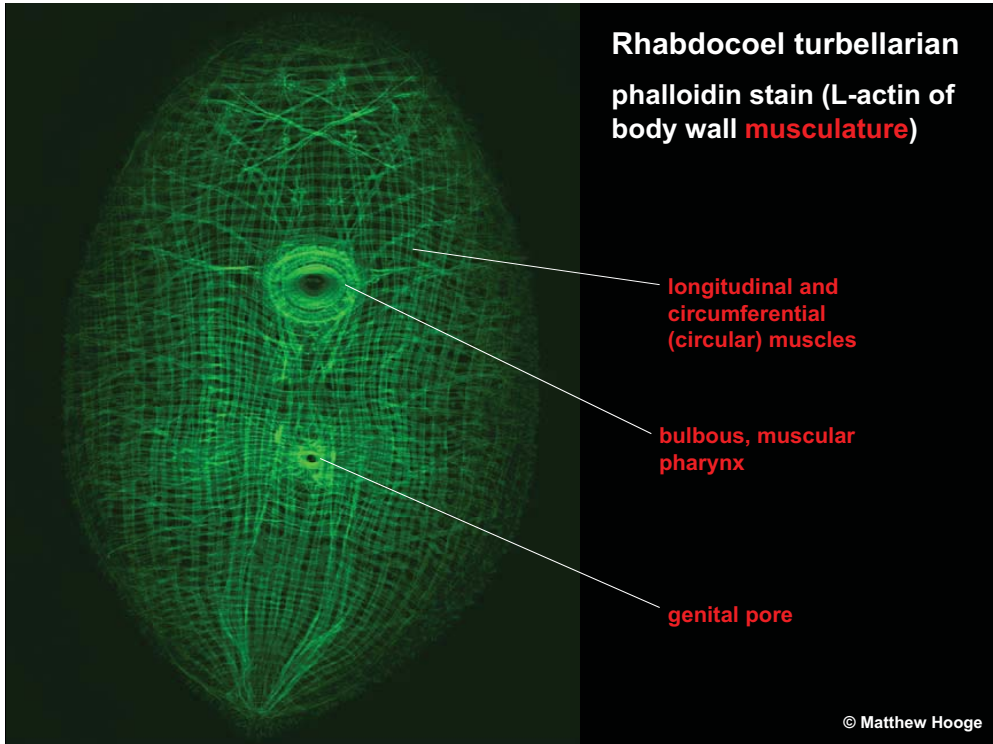


FIGURE 9-5 Bilateria: body-wall musculature. The basic arrangement of body-wall muscles in soft-bodied bilateral animals, as shown in B and the cross section (D), is an outer circular and an inner longitudinal musculature. These two layers have antagonistic actions: Contraction of the circular musculature causes elongation of the body (A), whereas contraction of the longitudinal musculature causes shortening (C). Longitudinal muscles alone allow the animal to bend and turn. The circular body wall muscles typically are positioned outside of the longitudinal muscles because the effectiveness of their action (elongation or peristalsis) depends on compression of the bodily tissues, including the longitudinal musculature.



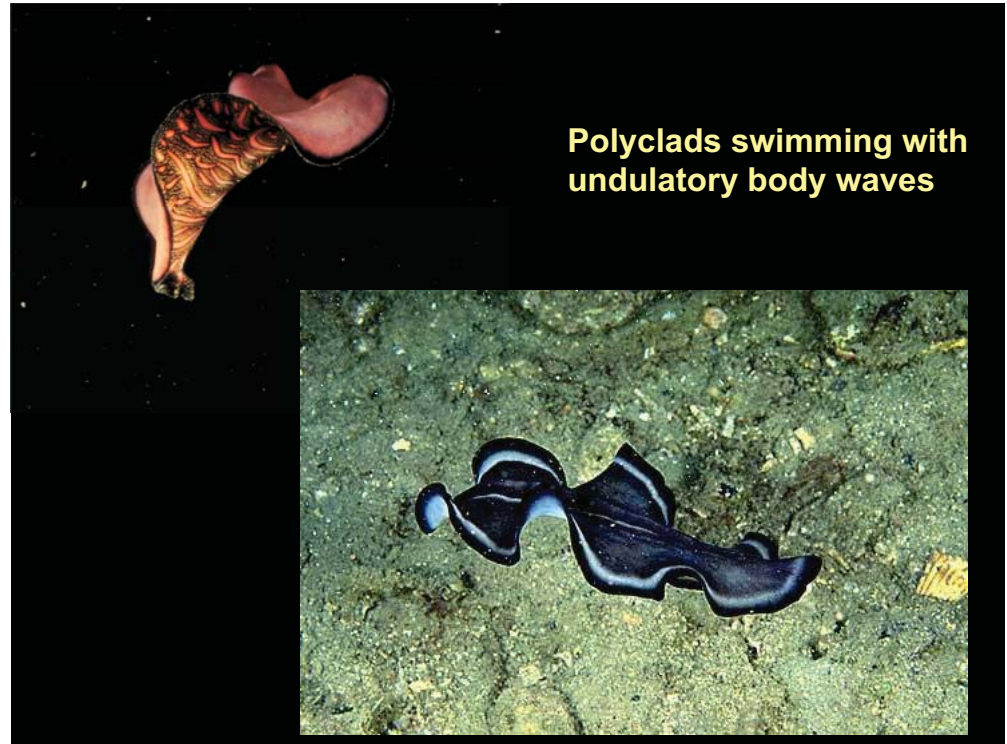
Rhabdoceol turbellarian

phalloidin stain (L-actin of body wall musculature)

longitudinal and circumferential (circular) muscles

bulbous, muscular pharynx

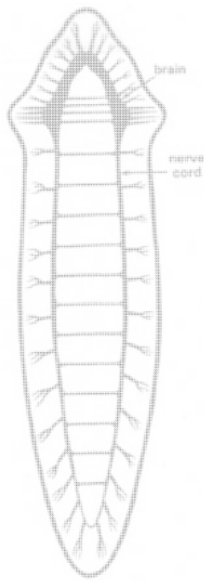
genital pore



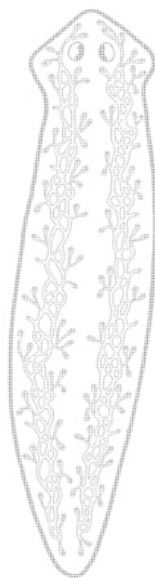
Polyclads swimming with undulatory body waves



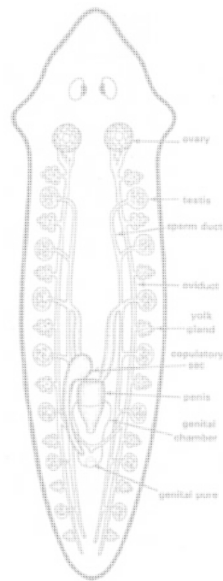
Digestive



Nervous



Excretory



Reproductive



ascidian

Turbellarians are often predatory specialists

polyclads feeding

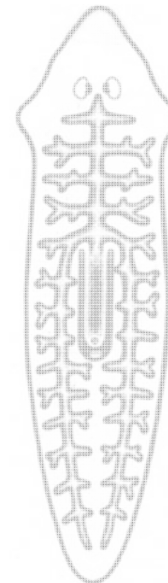
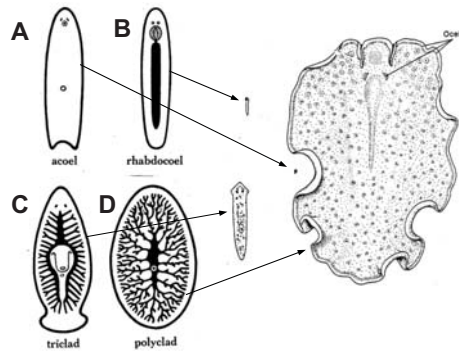
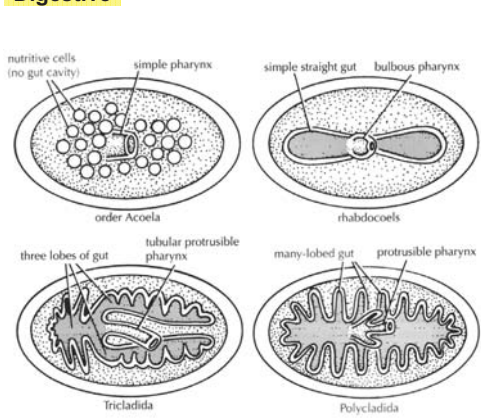


planarian feeding on a midge

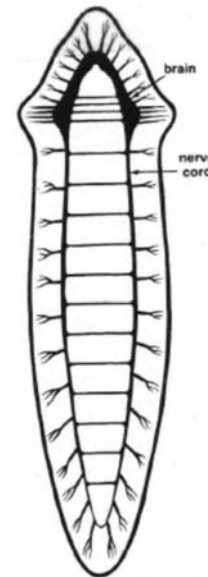


bryozoans

Digestive



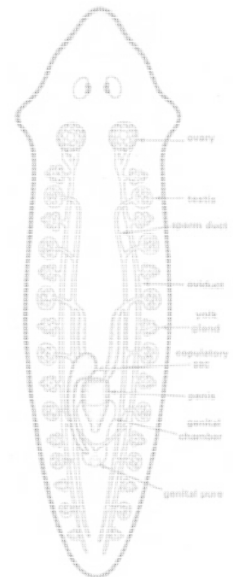
Digestive



Nervous

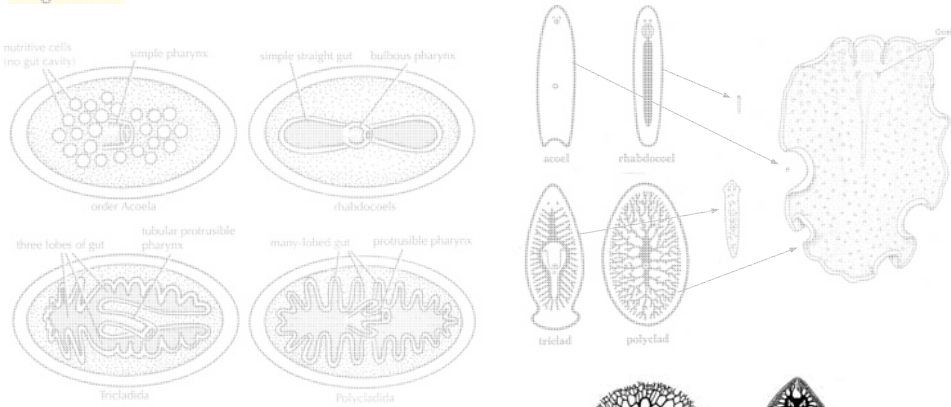


Excretory

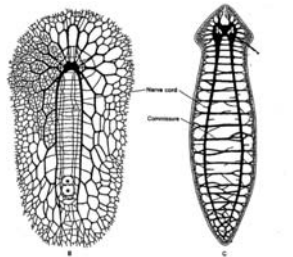
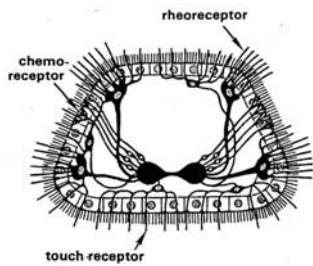


Reproductive

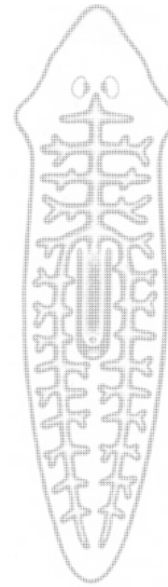
Digestive



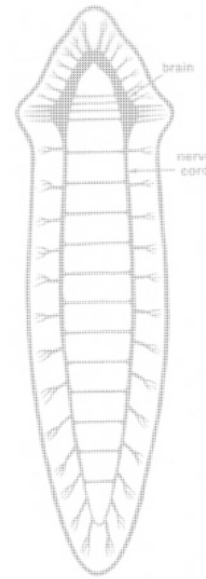
Nervous



The netlike arrangement of peripheral nerves is clear in polyclads (B, ventral nervous system) and triclad (C), but in triclad a regular series of transverse commissures imparts a segmental pattern on the nervous system.



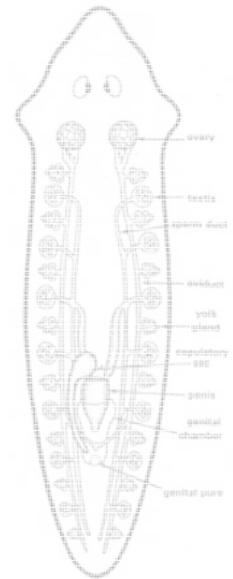
Digestive



Nervous

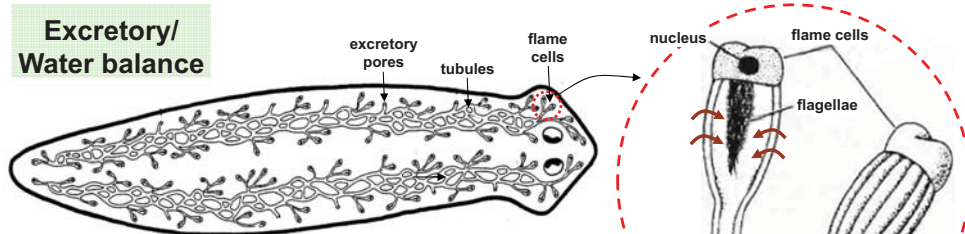


Excretory

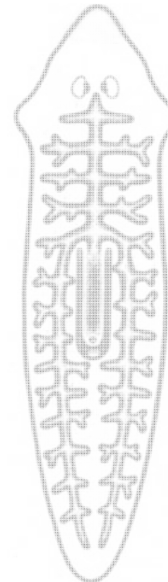
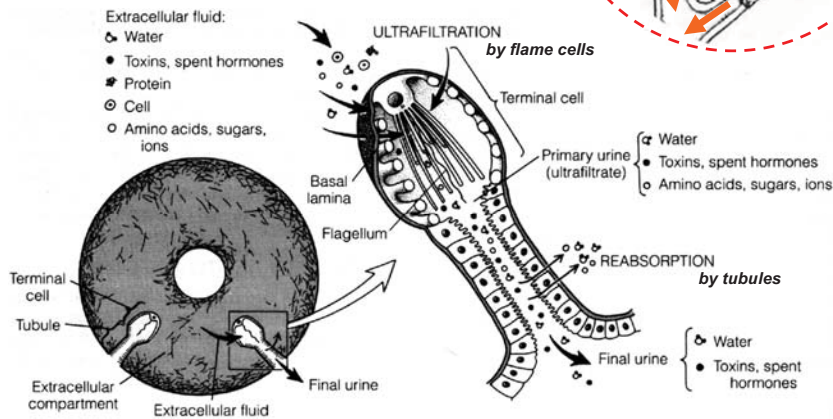


Reproductive

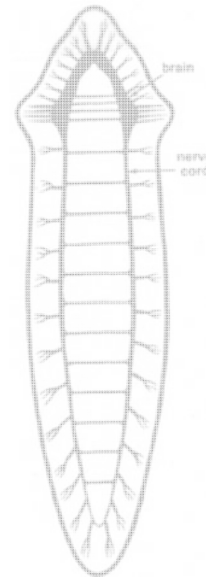
**Excretory/
Water balance**



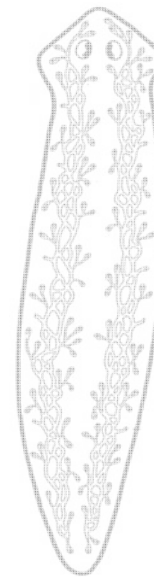
Protonephridial system



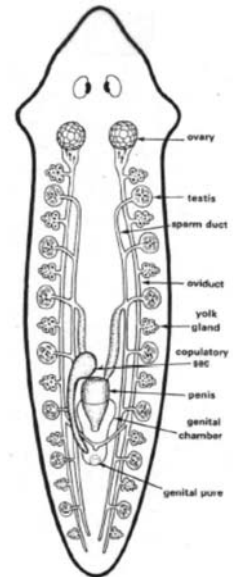
Digestive



Nervous



Excretory

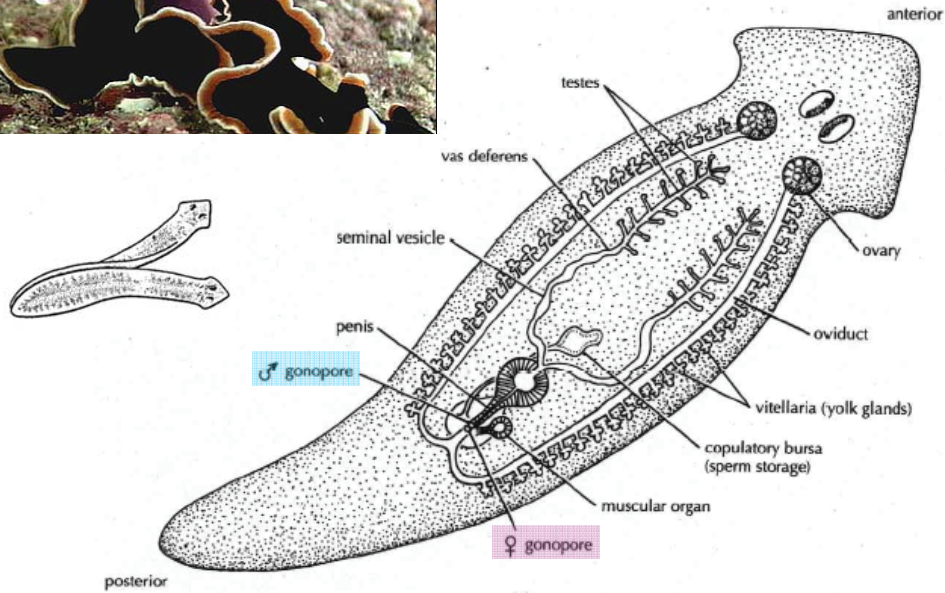


Reproductive

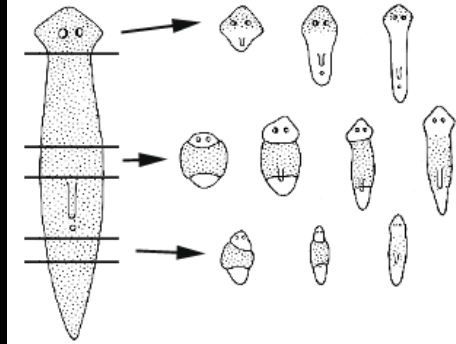


http://www.pbs.org/kcet/shapeoflife/episodes/hunt_explo2.html
<http://www.youtube.com/watch?v=5fx-YgcP8Gg> (0:43)
<http://www.youtube.com/watch?v=S0c3NyupRuY&NR=1> (0:35)

"Penis-fencing"



Asexual reproduction and regeneration

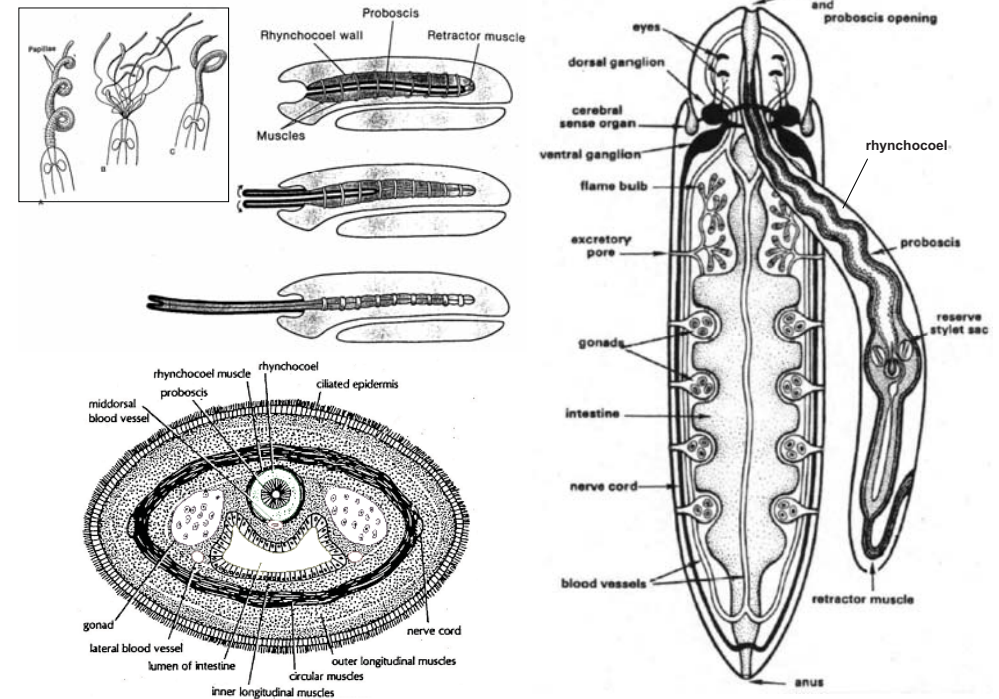


Ph. Nemertea (Ribbon Worms)

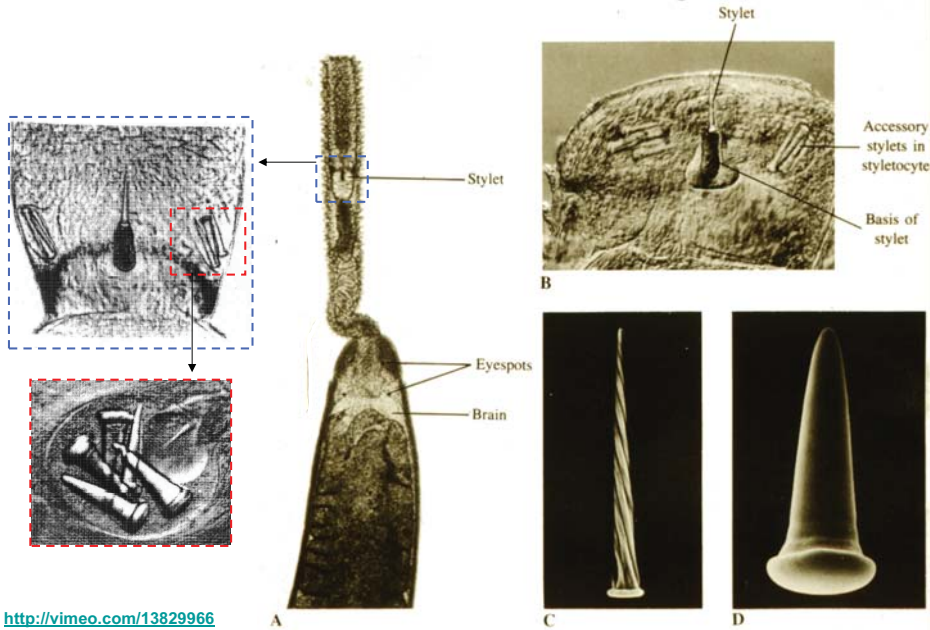


Themes: efficiency of a 1-way gut; novel structures

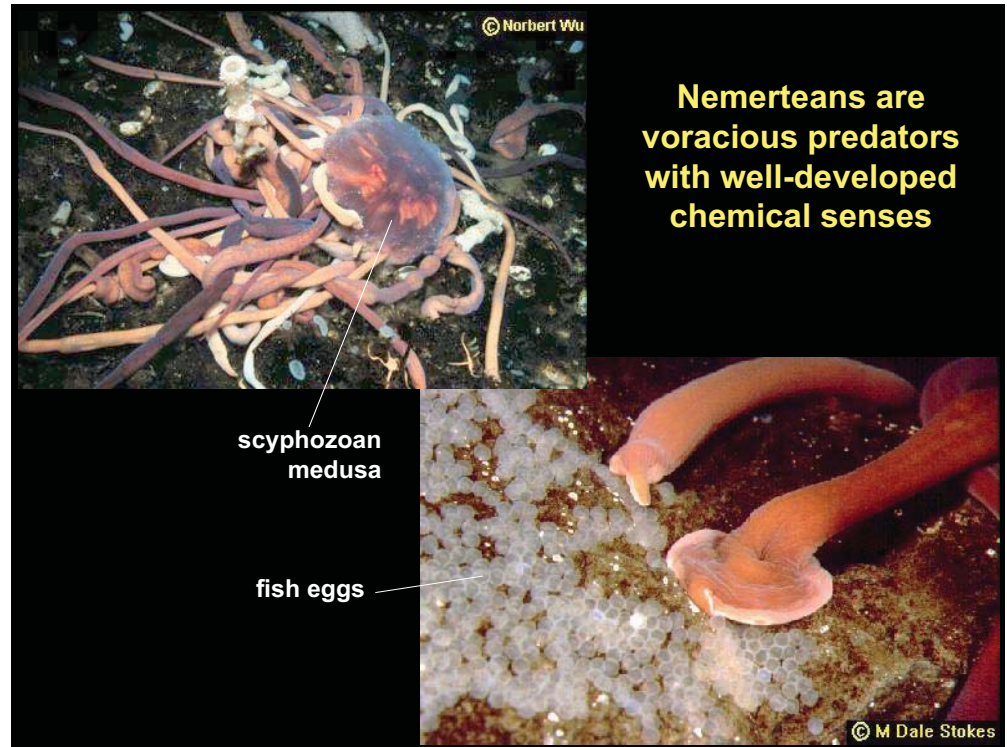
Ph. Nemertea: internal anatomy



nemertea = "unerring"



<http://vimeo.com/13829966>



© Norbert Wu

Nemerteans are voracious predators with well-developed chemical senses

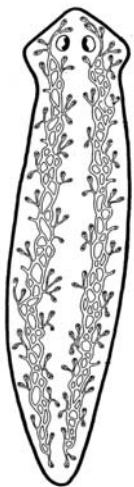
scyphozoan medusa

fish eggs

© M Dale Stokes

Excretory systems

Excretion in platyhelminths
protonephridial system



Excretion in nemerteans
protonephridial system
coupled to circulatory system

