

# SCAMIT 13 March 2017

## Heteronemertea

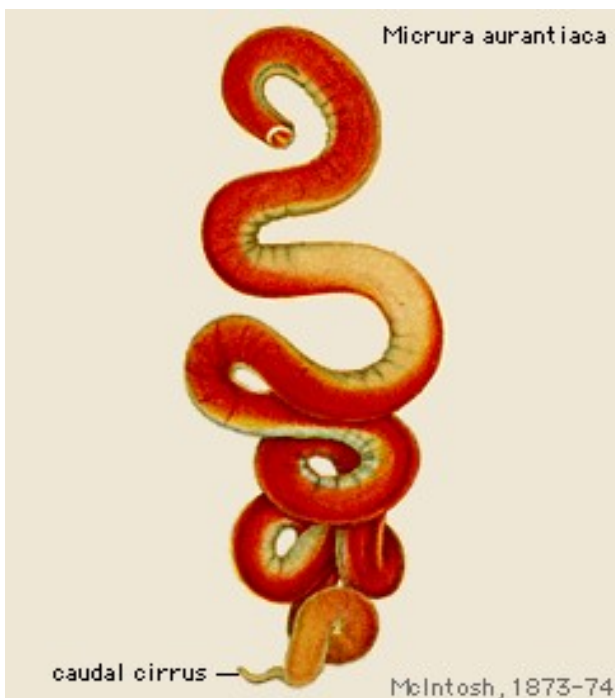
D. Pasko



*Lineus pictifrons*, Photo courtesy of L. Harris

# Nemertea

- Mostly marine and benthic, but some freshwater & terrestrial representatives
- Unsegmented, bilaterally symmetrical, vermiform, soft-bodied organisms
- Very elastic (capable of great contraction/elongation)
- Nemerteans demonstrate cephalization and have a well developed nervous system with lateral nerves and sense organs (cerebral and lateral), closed circulatory system, and a complete gut, but otherwise without appendages
- Nemerteans are unique in possessing an eversible proboscis for catching prey
  - **Anopla**: unarmed proboscis (mouth and proboscis pore separate)
  - **Enopla**: armed proboscis (mouth and proboscis pore united)
- Most are drab colored, especially when preserved, but some are brightly colored and quite distinctive, even in preservation.
- Sizes range from minute to a species of lineid reaching extended lengths of 60 m.
- Fragment frequently upon collection, screening, and fixation
- Body consists of
  - Head: proboscis pore, brain ganglia, eyes when present
  - body (or trunk): mouth, esophageal region, intestinal region
  - “tail:” anus and caudal cirrus when present
- Now recognized as coelomates, and related to annelids and molluscs, where they had been previously associated with the acoelomate flatworms – The circulatory system and rhynchocoel are now recognized as being formed by a coelom.
- Taxonomy is often difficult because true differences among species are characterized by color in life or histological differences.





# Nemertea: Two Classes

## ENOPLA

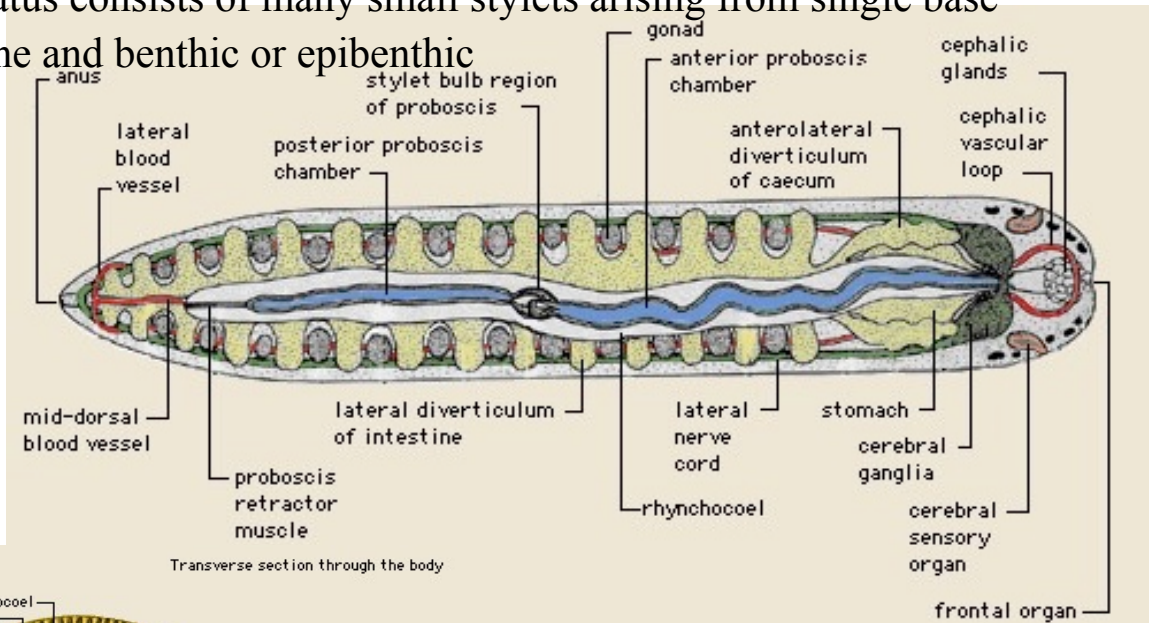
- Mouth and proboscis pore united to one shared opening
- Mouth typically anterior to brain ganglia
- Proboscis armed with stylet, and organized into 3 specialized regions
- Lateral nerve chords located within mesenchyme, internal to body wall muscles

## Monostylifera

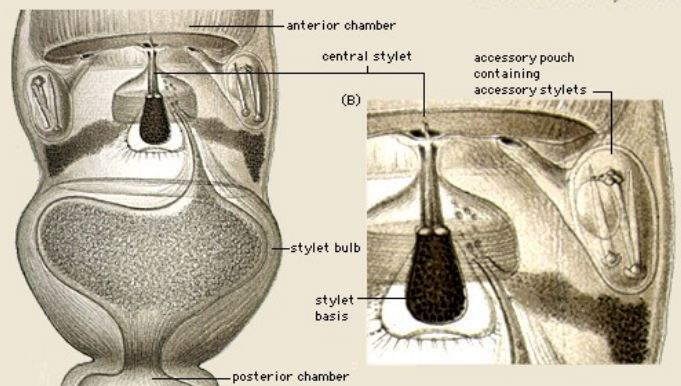
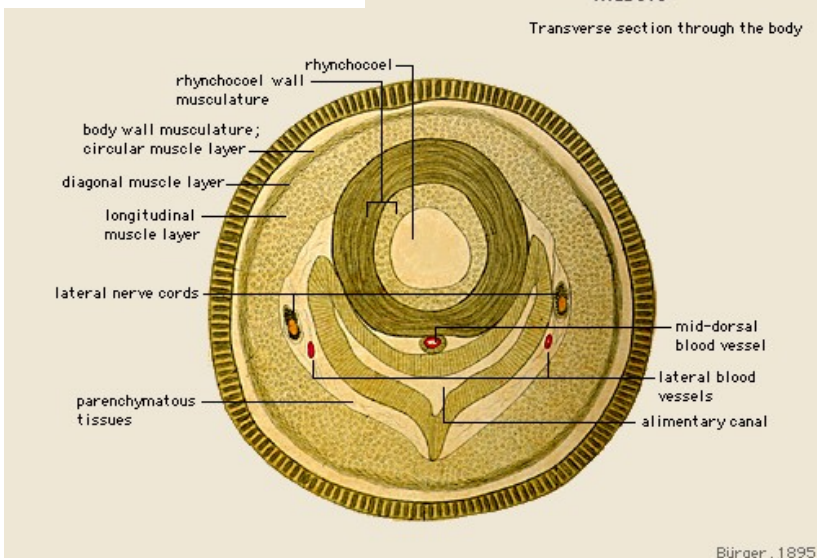
- Stylet apparatus consists of single stylet + two or more accessory stylet pouches
  - Single exception is with *Malacobdella*, which has unarmed proboscis, large posterior sucker on trunk, and convoluted gut lacking diverticula
- Most are marine and benthic, but freshwater, terrestrial, and parasitic/commensals also known

## Polystylifera

- Stylet apparatus consists of many small stylets arising from single base
- All are marine and benthic or epibenthic



after: Gibson, 1982



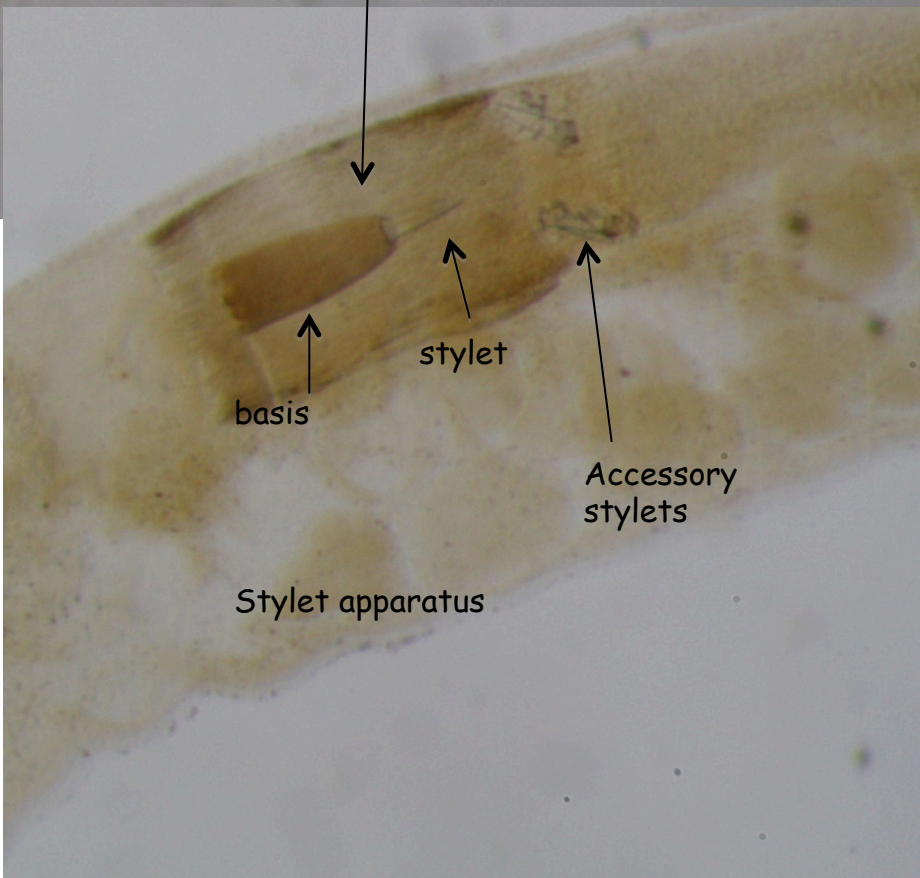
Bürger, 1895

Bürger, 1895



# Nemertea: Two Classes

## ENOPLA: Monostylifera (Cleared)





# Nemertea: Two Classes

## ANOPLA

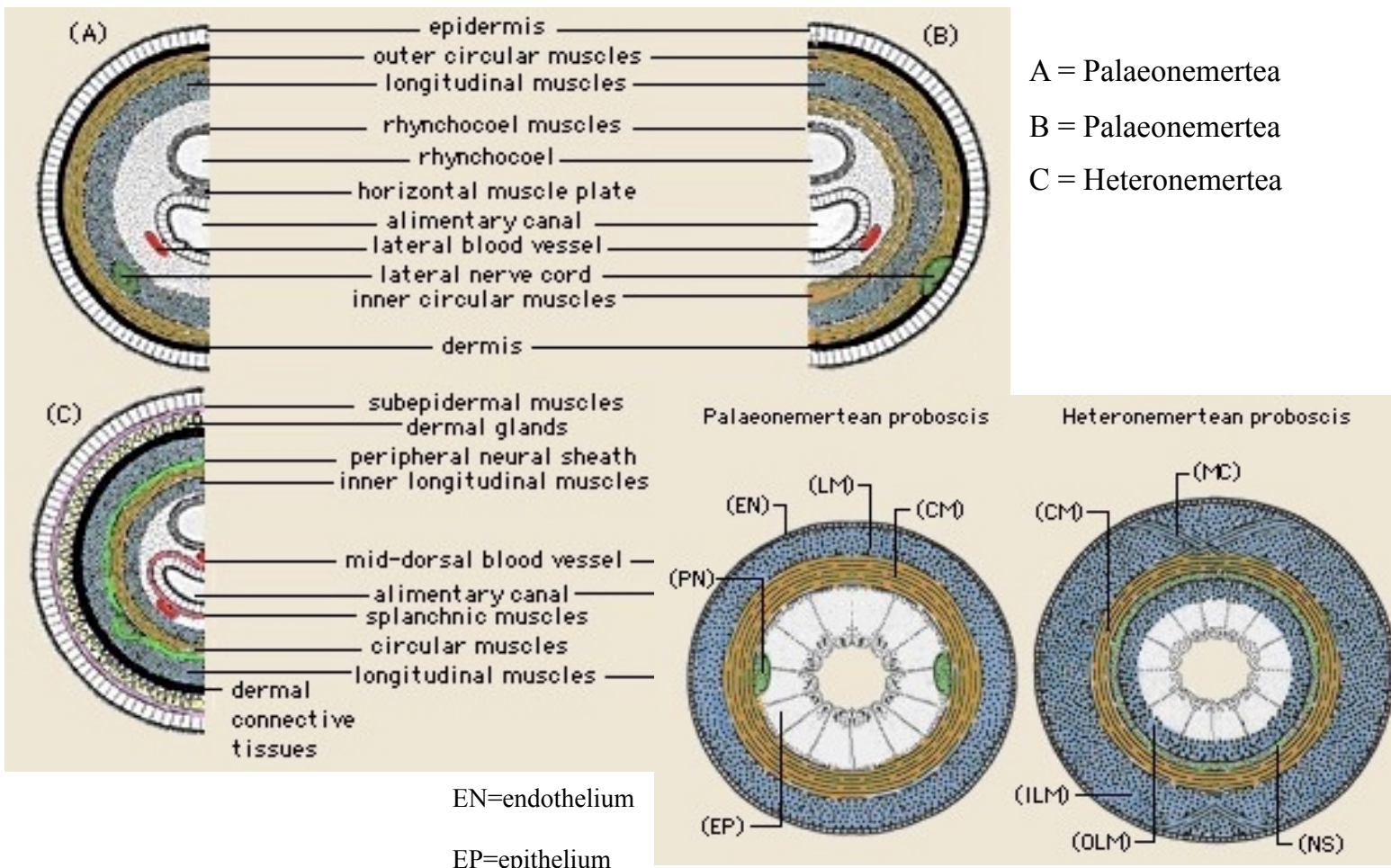
- Mouth and proboscis pore separate
- Proboscis unarmed, and not specialized into three regions
- Mouth located below or posterior to brain ganglia
- Lateral nerve chords (LNC) located within epidermis, dermis, or body wall musculature

### Palaeonemertea

- Two or three layers of wall muscles
  - Outer circular – Mid longitudinal – Inner circular
  - Outer circular – Mid longitudinal
- LNC in epidermis, dermis, or within longitudinal muscle
- Dermis thin, gelatinous or absent
- Cerebral sense organs (CSO) and eyes (ocelli) often absent
- Proboscis primarily 2-layered, with proboscis nerve (PN)

### Heteronemertea

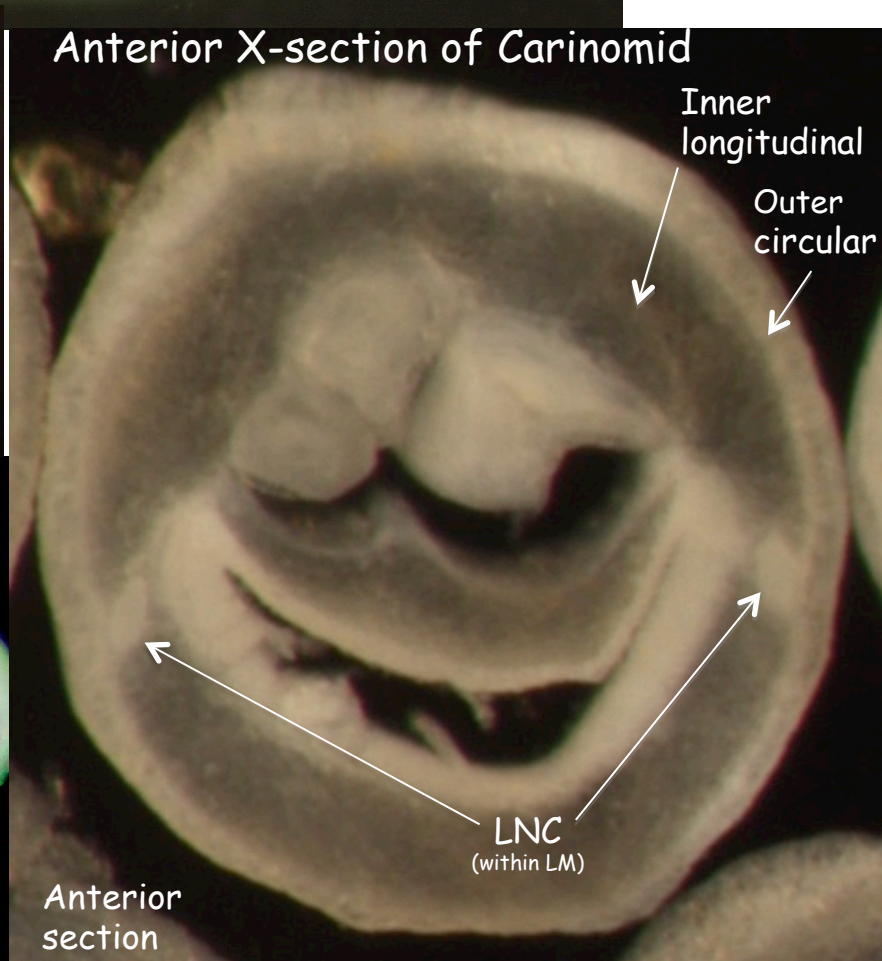
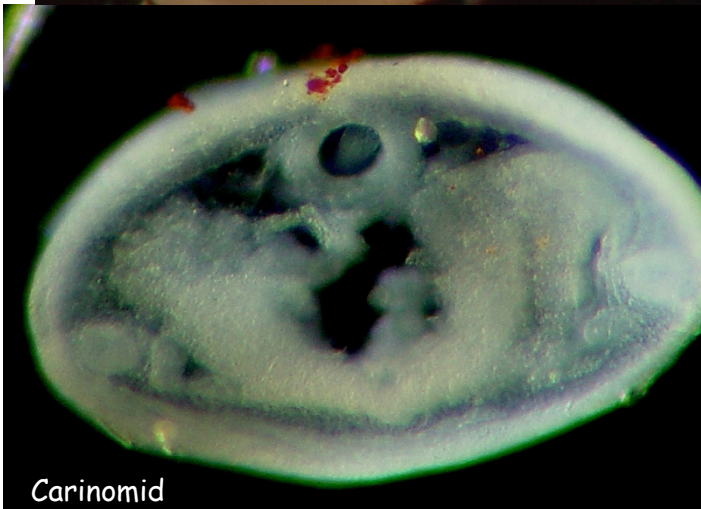
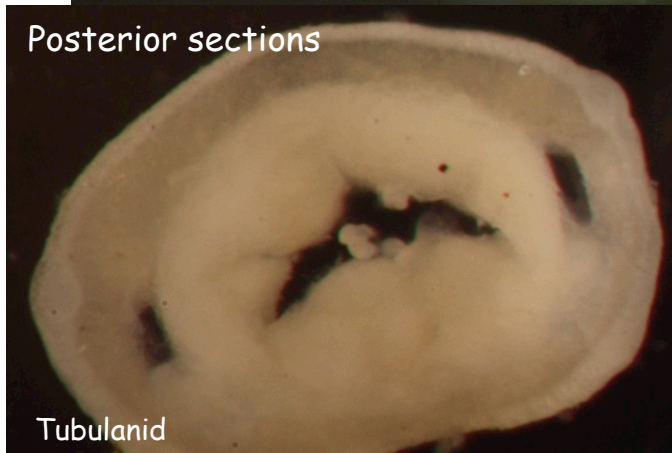
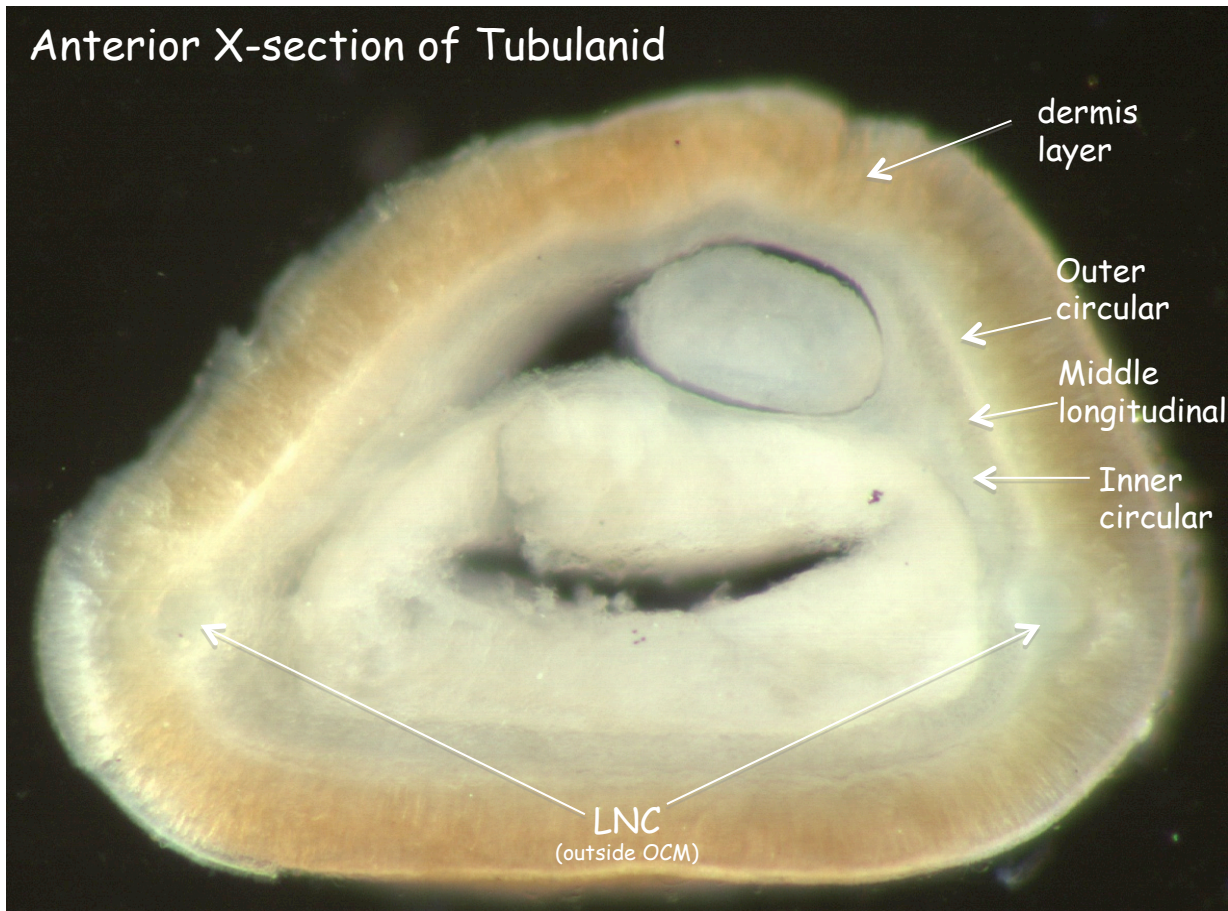
- Three layers of wall muscles
  - Outer longitudinal – Mid circular – Inner longitudinal
- LNC between outer longitudinal & mid circular muscle layers
- Dermis thick, fibrous, gelatinous or absent
- CSO and eyes (ocelli) often present
- Proboscis primarily 3-layered, with neural sheath (NS) and muscle crosses (MC)





# Nemertea: Two Classes

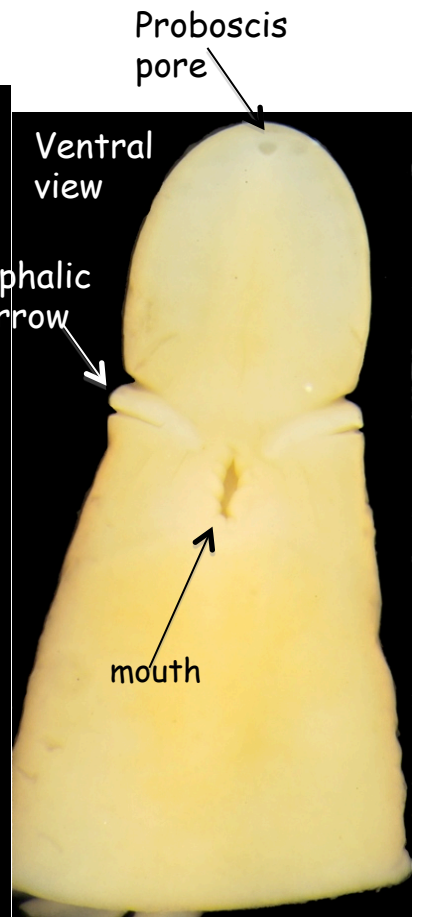
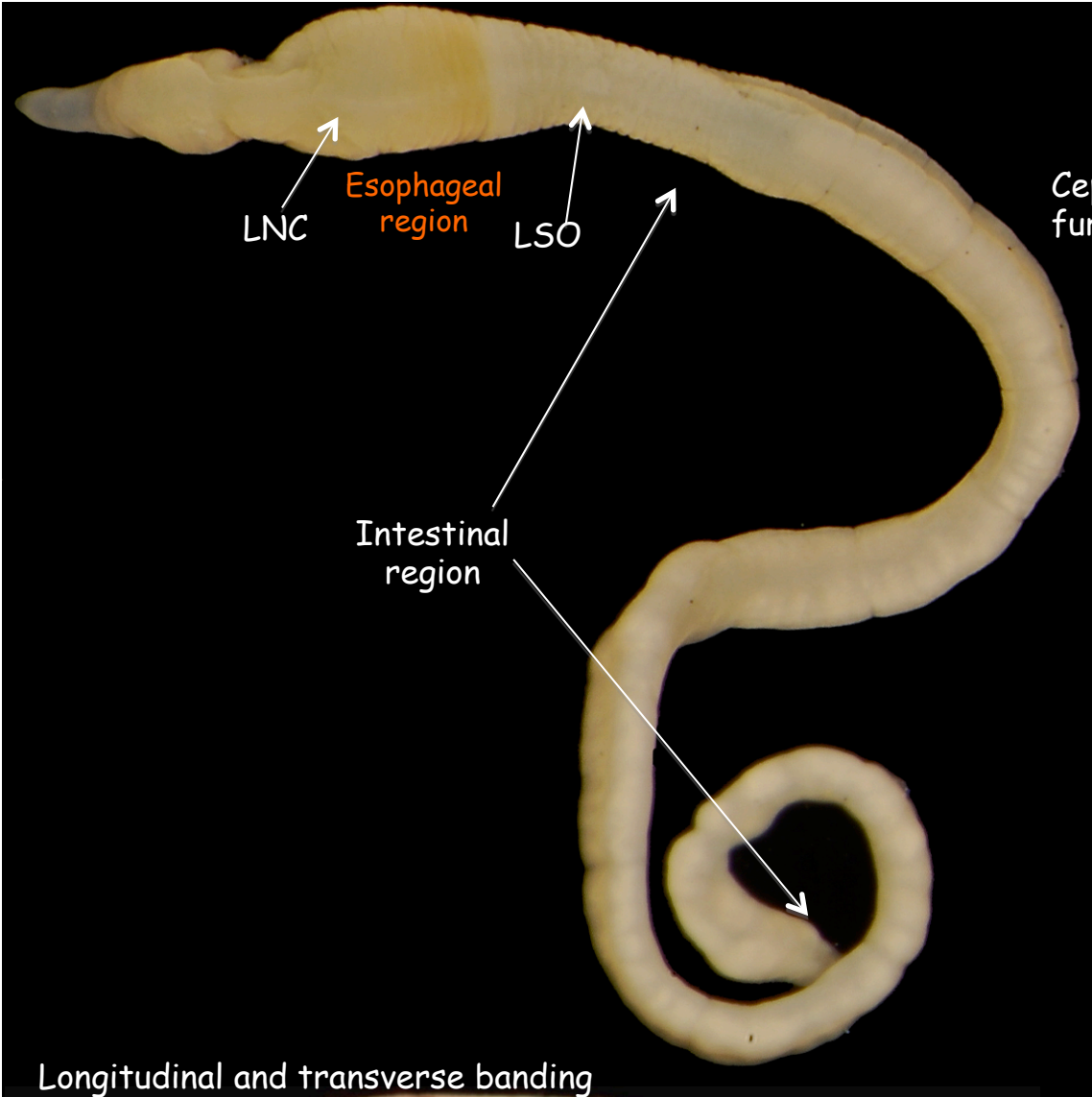
ANOPLA: Palaeonemertea: 3- and 2-layer musculature



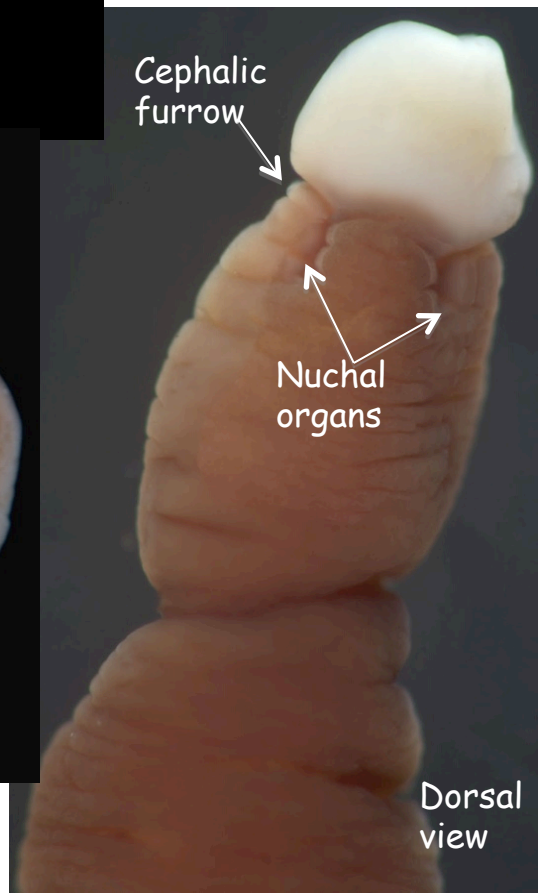
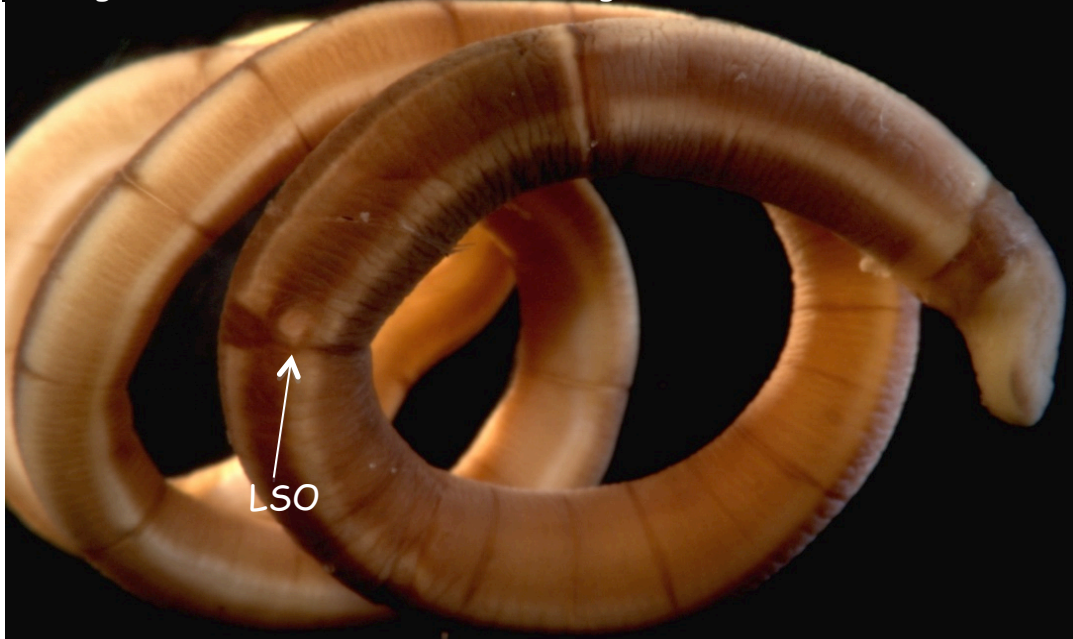


# Nemertea: Two Classes

## ANOPLA: Palaeonemertea



Longitudinal and transverse banding

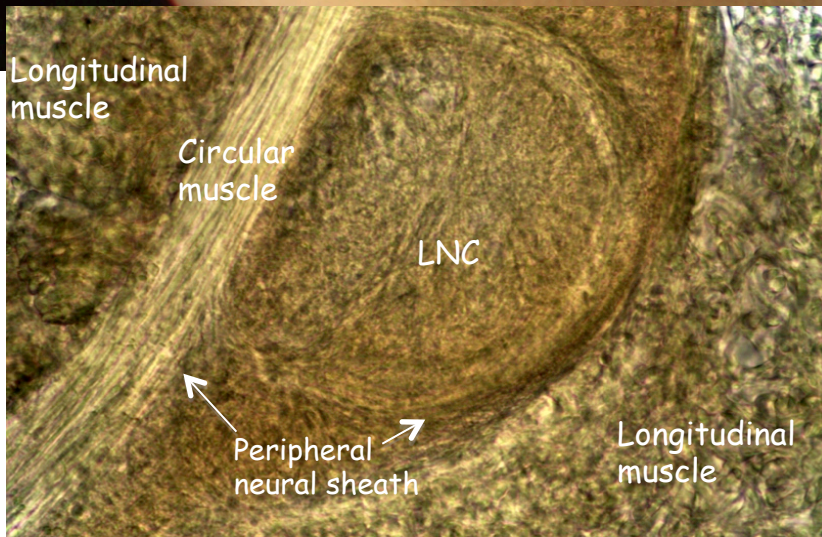
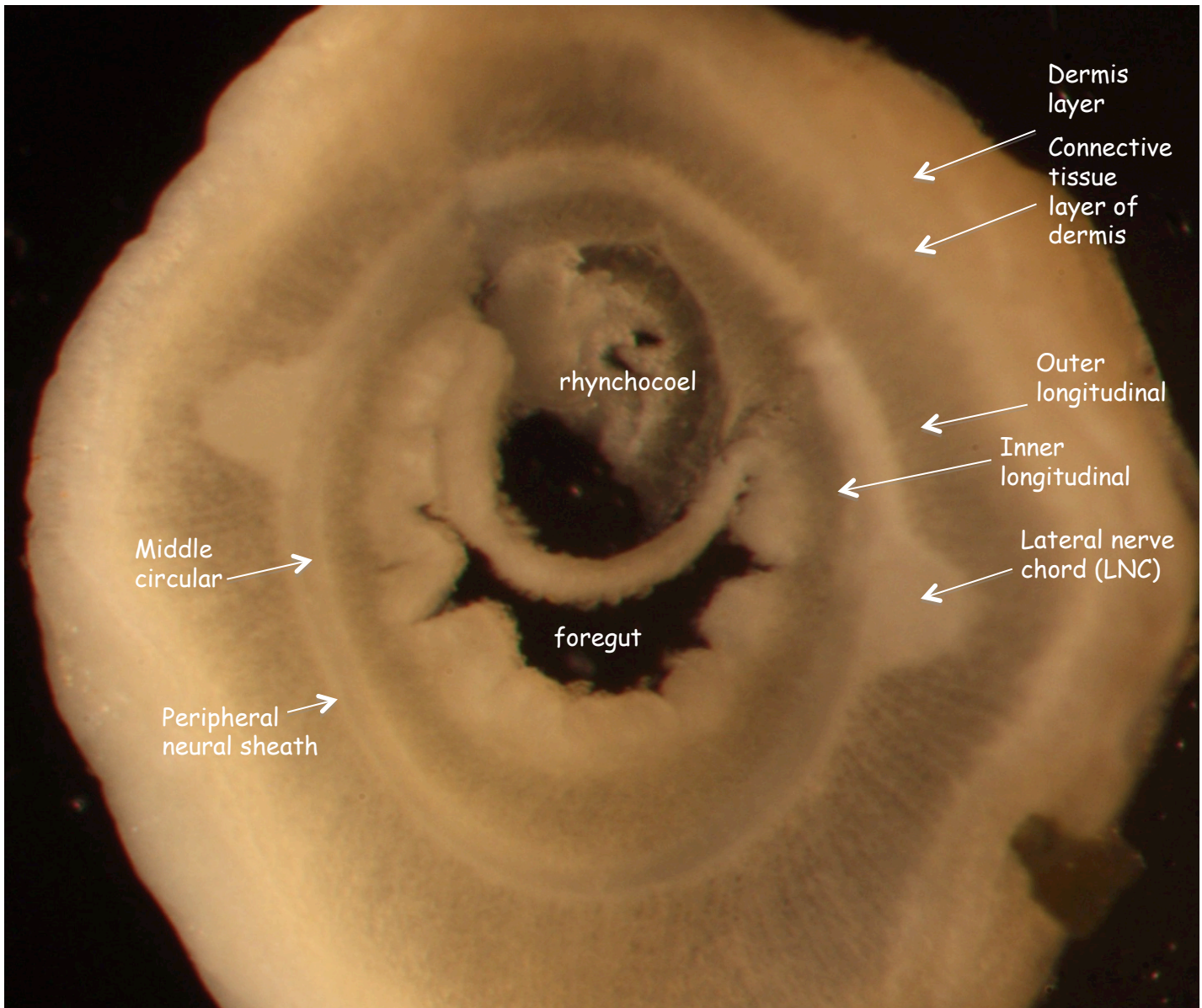


Dorsal view

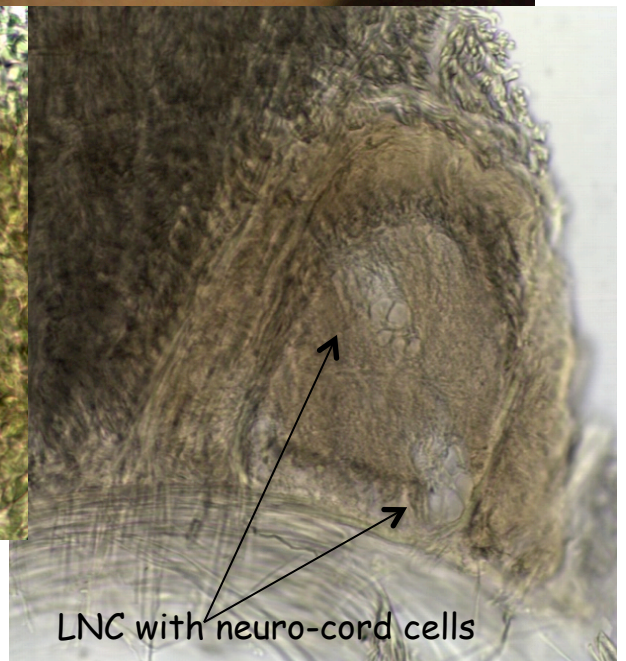


# Nemertea: Two Classes

## ANOPLA: Heteronemertea: 3-layered musculature



LNC without neurocord cells

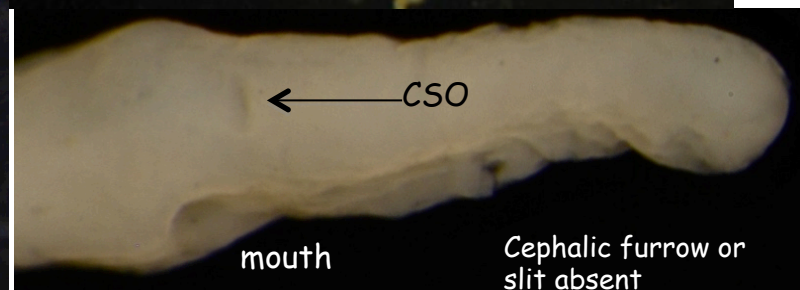
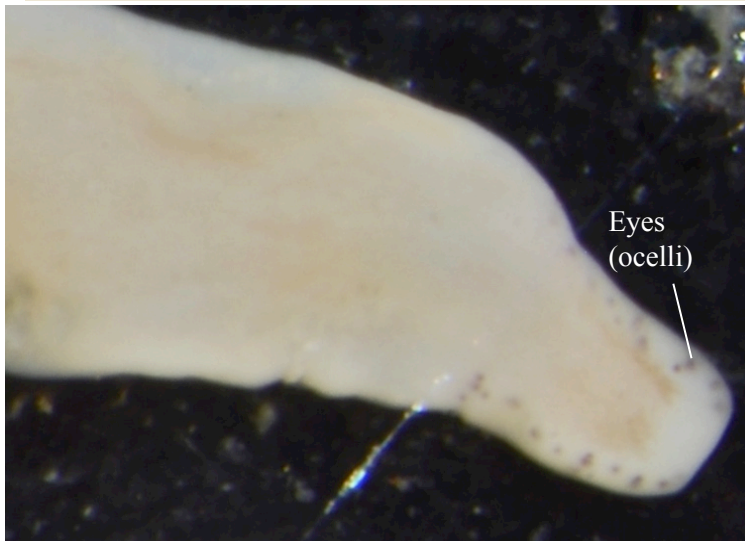
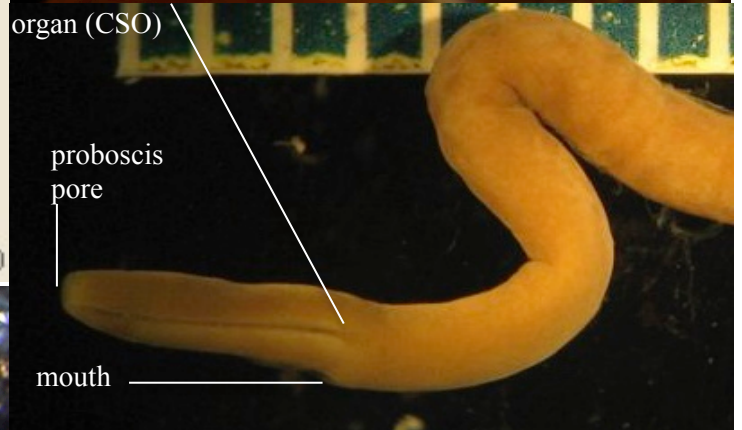
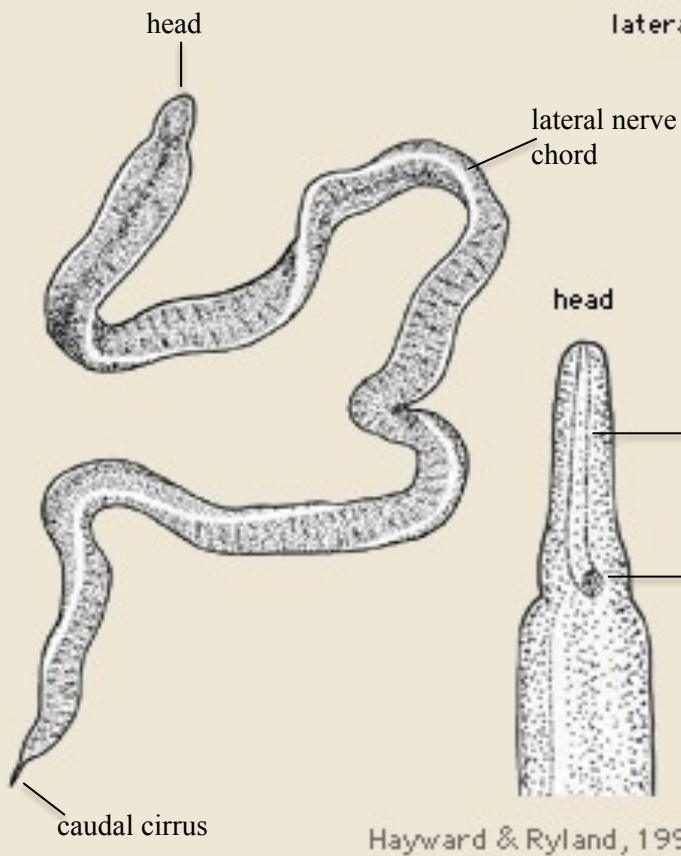
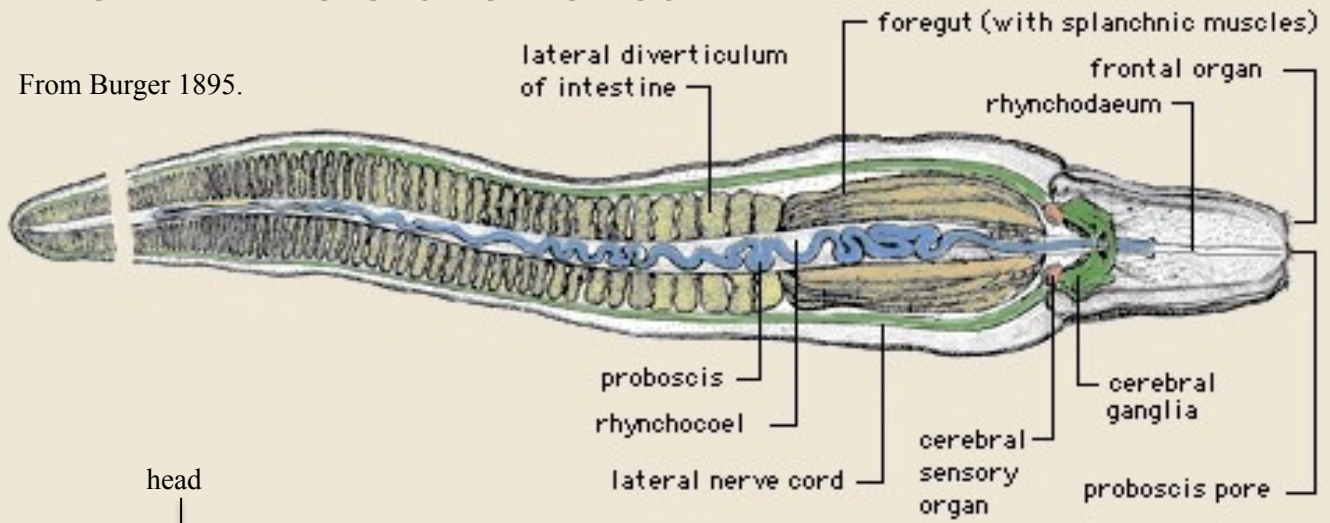




# Nemertea: Two Classes

## ANOPLA: Heteronemertea

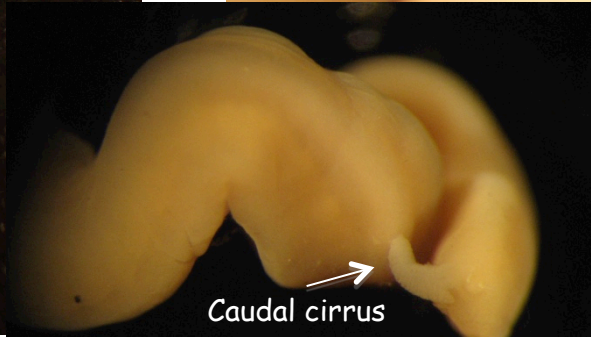
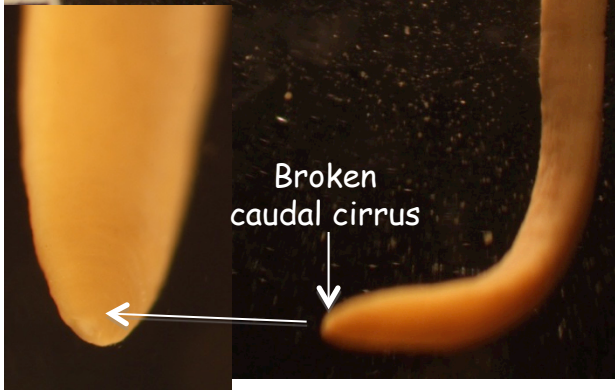
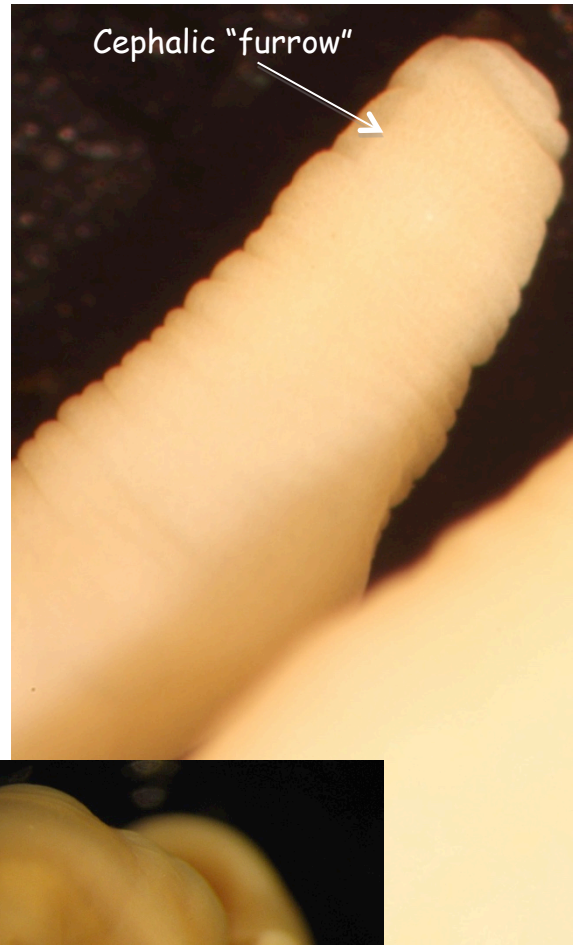
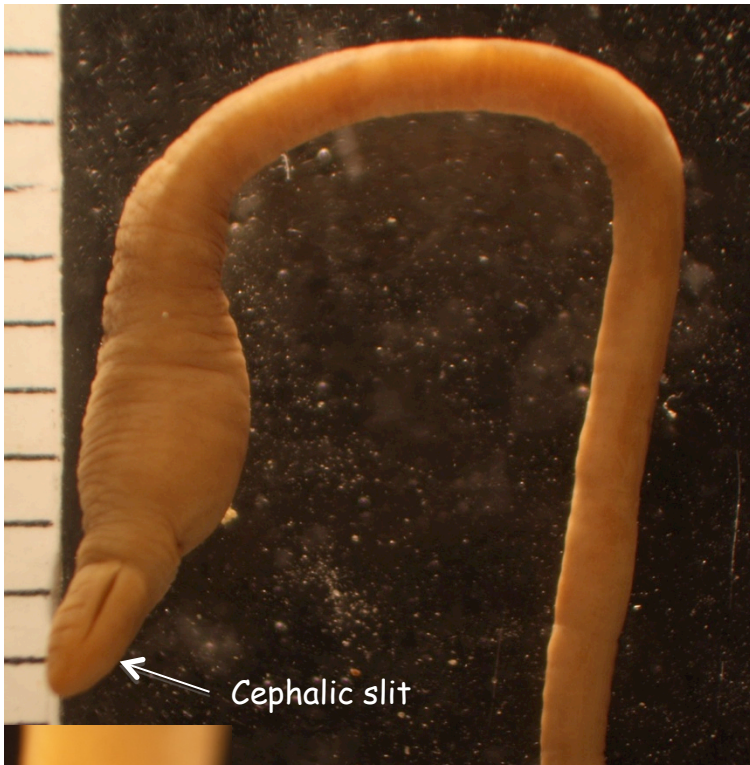
From Burger 1895.



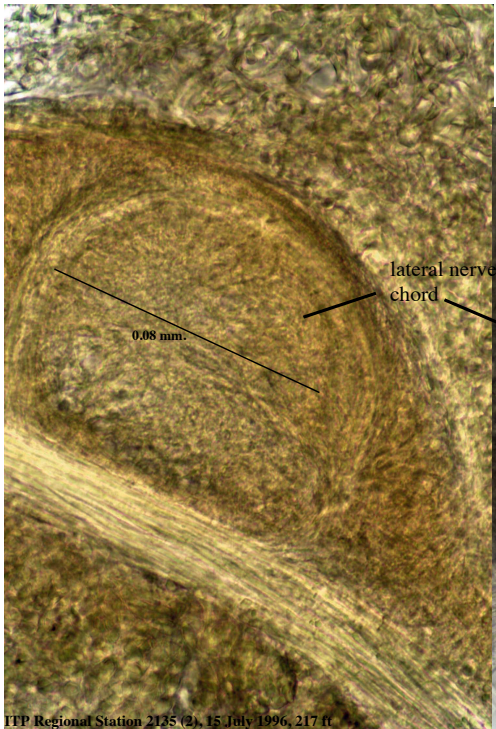


# Nemertea: Two Classes

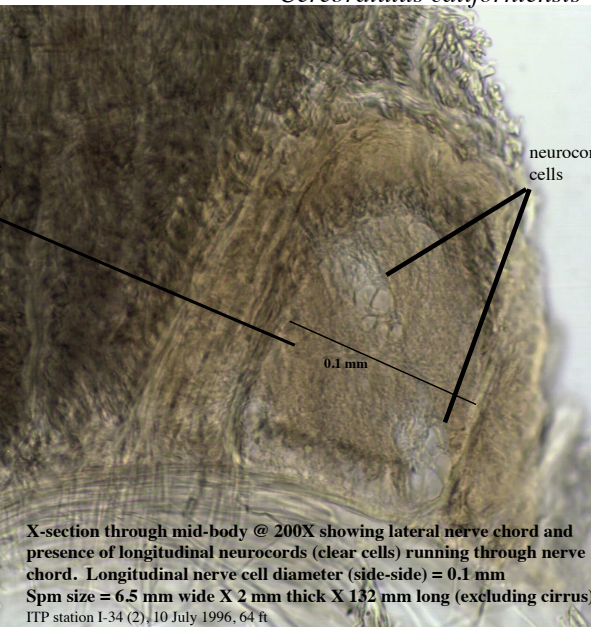
## ANOPLA: Heteronemertea:



*Micrura alaskensis*: X-section through mid-body showing lateral nerve chord @ 400X. diameter of nerve chord = 0.08 mm. Note absence of longitudinal neurocord cells found in *Cerebratulus*. Spm size = 5 mm wide X 2.5 mm thick X ~46 mm long (excluding cirrus).



*Cerebratulus californiensis*



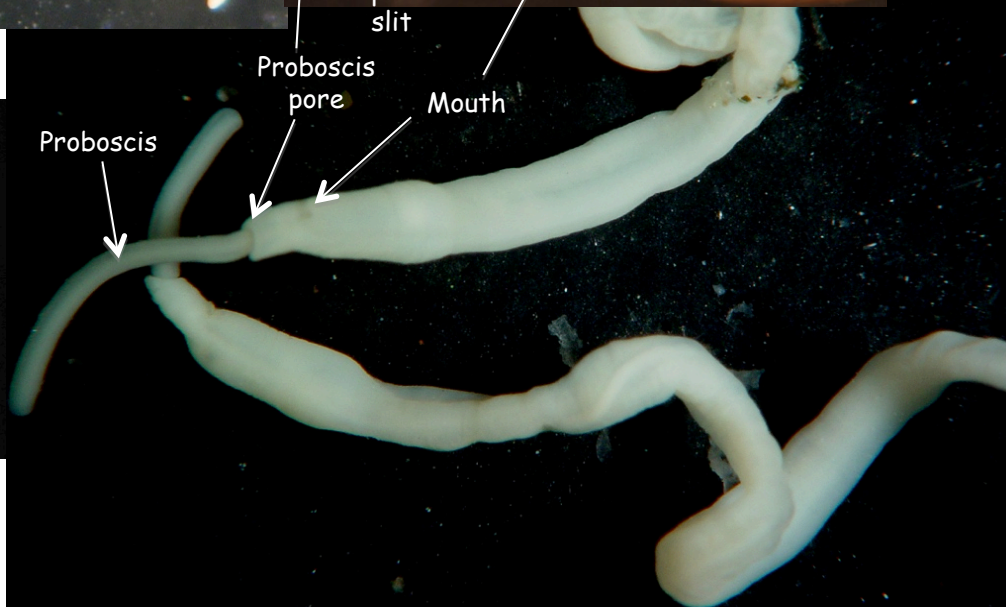
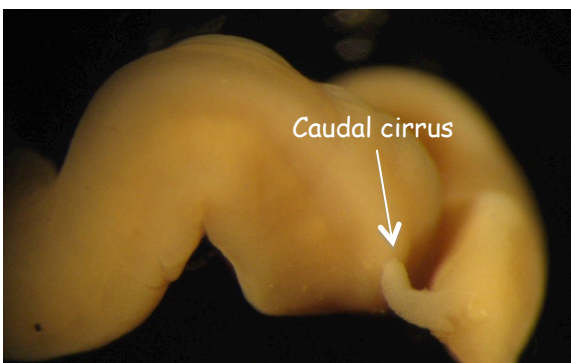
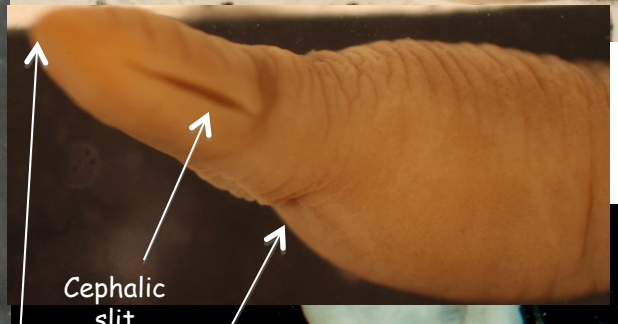
X-section through mid-body @ 200X showing lateral nerve chord and presence of longitudinal neurocords (clear cells) running through nerve chord. Longitudinal nerve cell diameter (side-side) = 0.1 mm  
Spm size = 6.5 mm wide X 2 mm thick X 132 mm long (excluding cirrus).  
ITP station 1-34 (2), 10 July 1996, 64 ft



# Nemertea: Anopla

## Characters used to differentiate taxa

- Basic character state of body: rounded, dorso-ventrally flattened, wrinkled, lateral margins, etc.
- Proboscis and mouth: united vs. separate (Anopla vs. Enopla)
- Cephalic slit: presence/absence/present but poorly differentiated (furrow, line)
- Musculature: 2- vs. 3-layered; orientation of layers (outer circular vs. outer longitudinal), and relative thickness and positioning of the layers (dermis, muscle layers, etc.)
- Mouth: position relative to brain and cephalic slit, size, muscularity, shape
- Eyes (ocelli): present/absent/number and arrangement
- Cerebral sense organ (CSO)/Lateral sense organ (LSO): present vs. absent, shape, presentation, position relative to mouth (CSO)
- Neurochords (nerve chords): position relative to muscle layers
- Neurochord cells: present/absent (*Cerebratulus* vs. other lineids)
- Caudal cirrus: present vs. absent
- Coloration: present vs. absent vs. patterned

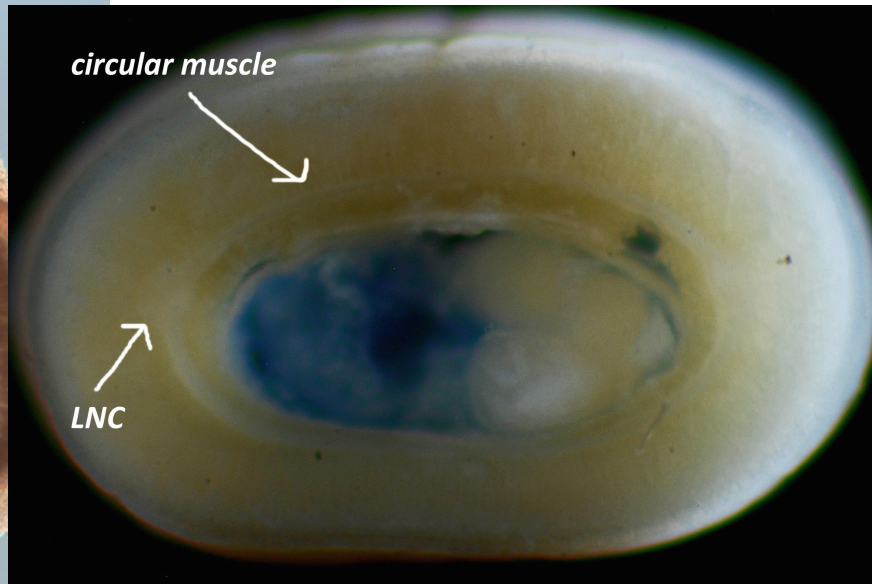
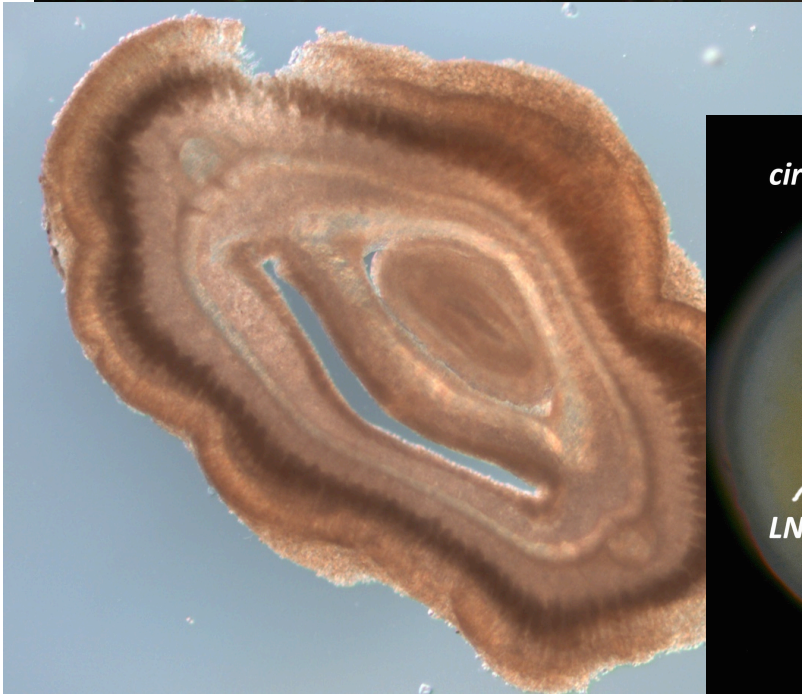
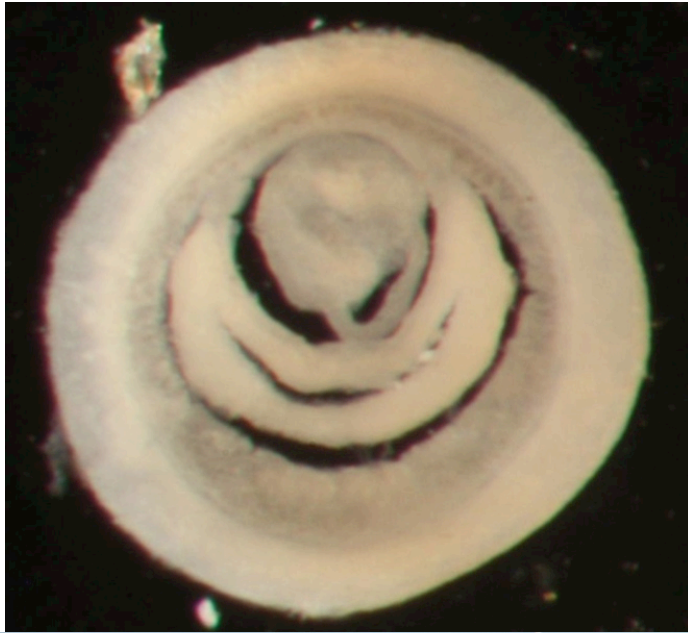




# Nemertea: Anopla

Characters used to differentiate taxa

Heteronemertean musculature





# Nemertea

## *Problems with identification*

### **Problems of identifications:**

- Often tangled or wrinkled making it difficult to see characters (CSO, mouth, etc.) or to make appropriate cross-sections
- Often fragmented so presence/absence of caudal cirrus can be impossible to determine
- Neutral color of animal make it difficult to see subtle traits (presence of CSO, LSO, neurochord cells)
- Small sizes of specimens – we're often stretching the limits of prudent identification
- Nature of specific characters (e.g., CSO, muscle crosses, neurocord cells) make them difficult to see or distinguish with confidence
- Coloration from life often faded or may be altered in preservation
- Cross-sections are often necessary to distinguish specimens – requires time, dexterity, and patience
  - Differences in musculature can be difficult to distinguish

### **Problems identified in the literature:**

- There are 1,275 named/described species; but over one-half were described before 1900, with many descriptions so vague that they cannot be used to identify species, and in many cases it is not particularly clear what the name actually refers to (Sundberg, Vodoti, and Strand, 2009)
- The inadequacy descriptions of new species currently presents [adds to] the main challenge of nemertean taxonomy (Herrera-Bachiller et al, 2015).
- The simplicity of the nemertean body plan and the high degree of homoplasy (shared character state though from different ancestry) is the commonly used morphological characters suggest that there are likely a large number of unrecognized species. Recent DNA analysis has shown that species and species groups (genera) thought to be monophyletic are actually polyphyletic and contain multiple species (Kvist et al 2014)



# Nemertea

## Primary resources:

- Bernhardt, P. 1979. A key to the Nemertea from the intertidal zone of the coast of California. Unpublished
- Coe, W.R. 1905. Nemerteans of the west and northwest coasts of America. *Bulletin of the Museum of Comparative Zoology*, 47: 1–319
- Coe, W.R. 1940. Revision of the Nemertea fauna of the Pacific coasts of North, Central and northern South America. *Allan Hancock Pac. Exped.* 2(13): 247–323.
- Correa, D.D. (1964). Nemerteans from California and Oregon. *Proceedings of the California Academy of Sciences* 31, 515-558.
- Gibson, R. 1982. Nemertean. In: Parker (ed.), *Synopsis and Classification of Living Organisms*, Vol. 1. McGraw-Hill, New York, Pp. 823-846.
- Gibson, R. 1982. *British Nemerteans: Keys and notes for the identification of the species.* Cambridge University Press. 212 pp.
- Hyman, L.H. 1951. *The Invertebrates. Platyhelminthes and Rhynchocoela. The coelomate Bilateral.* Volume II. McGraw-Hill, New York.
- MacEwen, P. 1980. A key to the common Nemertea of southern California. unpublished.

See also SCAMIT NL Vol. 3, No. 4 (July 1984) for a complete listing of useful nemertean literature



# Most Commonly Reported Nemertea: Anopla

Class Anopla

## Order Archinemertea

### FAMILY CEPHALOTRICIDAE

*Cephalothrix* sp

## Order Palaeonemertea

### FAMILY CARINOMIDAE

*Carinoma mutabilis* Griffin 1898

*Carinomella lactea* Coe 1905

### FAMILY TUBULANIDAE

*Tubulanus albocinctus* (Coe 1904)

*Tubulanus capistratus* (Coe 1901)

*Tubulanus cingulatus* (Coe 1904)

*Tubulanus frenatus* (Coe 1904)

*Tubulanus polymorphus* Renier 1804

*Tubulanus* sp A SCAMIT 2005 §

*Tubulanus* sp SD1 Pasko 2000 §

Tubulanidae sp A SCAMIT 1995 §

Tubulanidae sp B SCAMIT 2005 §

Tubulanidae sp C SCAMIT 2005 §

Tubulanidae sp D SCAMIT 2005 §

Tubulanidae sp E SCAMIT 2005 §

### FAMILY UNCERTAIN

Palaeonemertea sp OC1 Pasko 2014 §

## Order Heteronemertea

### FAMILY LINEIDAE

*Cerebratulus albifrons* Coe 1901

*Cerebratulus californiensis* Coe 1905

*Cerebratulus lineolatus* Coe 1905

*Cerebratulus marginatus* Renier 1804

*Cerebratulus montgomeryi* Coe 1901

*Euborlasia nigrocincta* Coe 1940

Lineidae sp A Paquette 1989 §

Lineidae sp HYP 1 SCAMIT 2007 §

*Lineus bilineatus* (Renier 1804)

*Lineus flavescens* Coe 1904

*Lineus pictifrons* Coe 1904

*Lineus rubescens* Coe 1904

*Maculaura alaskensis* Cmplx

*Micrura coei* Gibson 1995

*Micrura wilsoni* (Coe 1904)

*Ramphigordius sanguineus* (Rathke 1799)

*Zygeupolia rubens* (Coe 1895)

### FAMILY VALENCINIIDAE

*Baseodiscus delineatus* (Delle Chiaje 1825)

*Baseodiscus princeps* (Coe 1901)

*Baseodiscus punnetti* (Coe 1904)

### FAMILY UNCERTAIN

Heteronemertea sp SD2 Lilly 2006 §

## Order uncertain

### FAMILY UNCERTAIN

Anopla sp C SCAMIT 1995 §

## Provisional Heteronemertea yet-to-be formalized

Heteronemertea sp Hyp1 Phillips 2012

Heteronemertea sp Hyp2 Pasko 2014

Lineidae sp SD1 Lilly 2015

[SCB heteronemertea](#)

# Nemertea: Anopla

## Key to the Anoplan Worms (Nemertea: Anopla) Reported from the Southern California Bight

D Pasko, M Lilly, CA Phillips

1. Mouth and proboscis pore united, combined mouth/proboscis pore opening located anterior to brain, distally or sub-distally..... **Enopla**<sup>i</sup>
  - Mouth and proboscis pore separate, proboscis pore anteriorly located on head (distally or sub-distally) and mouth ventral, either below or posterior to brain..... (Anopla)..... 2
2. Head with horizontal cephalic slit or represented by shallow furrow; body wall musculature three layered (outer longitudinal–middle circular–inner longitudinal)..... **Heteronemertea** [in part]..... 20
  - Head without horizontal cephalic slit..... 3
3. CSO<sup>1</sup> present or absent; body wall musculature with circular muscle representing the outer most layer: 3-layered (outer circular–middle longitudinal–inner circular) or 2-layered (outer circular–middle longitudinal)..... **Palaeonemertea**..... 4
  - CSO present; body wall musculature with longitudinal muscle representing the outer most layer: 3-layered (outer longitudinal–middle circular–inner longitudinal)..... **Heteronemertea** [in part]..... 35
4. Color pattern absent (i.e., body white, cream, uniform color)..... 5
  - Color present (i.e., body not uniformly colored)..... 9
5. Mouth small, situated far behind brain (5 to 15 body diameters behind brain); body slender, filiform and typically coiled; body wall musculature two-layered posteriorly..... **Cephalothrix** sp
  - Mouth not markedly small, situated close to brain (1–3 body diameters behind brain); body not filiform; body wall musculature two- or three-layered..... 6
6. Esophageal region swollen, papillated and differentially colored from remainder of cream-white colored body; CSO present, small, in line with mouth; two-layered palaeonemertean body wall musculature (outer circular–inner longitudinal)..... **Palaeonemertea** sp **OC1**
  - Esophageal region not markedly swollen or papillated..... 7
7. CSO present; caudal cirrus present; head tapered; three-layered heteronemertean body wall musculature..... 20<sup>ii</sup>
  - CSO absent; caudal cirrus absent; two-layered palaeonemertean musculature..... 8
8. LSO<sup>2</sup> absent; lateral nerve chord located interior to outer circular muscle, imbedded within inner-longitudinal muscle layer in esophageal region and throughout length of body; intestine with paired diverticula (visible upon clearing)..... **Carinoma mutabilis**
  - LSO present; lateral nerve chord outside of outer-circular muscle layer in esophageal region, but is imbedded within middle-longitudinal muscle layer in intestinal region, extension of circular muscle often encircling lateral nerve chord intestine without paired diverticula (visible upon clearing)..... **Carinomella lactea**<sup>iii</sup>
9. LSO absent..... 10
  - LSO present..... 13
10. Head not set off from body by difference in color or presence of transverse cephalic groove; distinct preservation band present in esophageal region; CSO present..... 11

<sup>1</sup> CSO = Cerebral sense organ located on side of head, typically anterior to mouth

<sup>2</sup> LSO = Lateral sense organ, a distinctly glandular area with sensory pit, located along the lateral nerve chord and typically within the esophageal region of many palaeonemerteans.



# Nemertea: Anopla

- Head set off from body by transverse cephalic groove; preservation band indistinct; distinct CSO absent ..... 12
- 11. [Note 3 choices] Head and body cream colored with brown speckling anteriorly; preservation band often set off by thin white band along anterior margin; CSO distinctly “C” shaped structure, located anterior of mouth ..... **Tubulanidae sp B**
- Head and body cream colored without brown speckling; preservation band not set off by thin white band; CSO distinctly “triangle” shaped structure..... **Tubulanidae sp C**
- Head and body brownish, head slightly lighter than body; preservation band set off by thin white band but not by change in color ..... **Tubulanidae Hyp2**
- 12. Head white, sharply demarcated from brown body by distinct cephalic groove; nuchal organs present (may be absent in juveniles or not apparent in contracted specimens) ...  
..... **Tubulanidae sp A**
- Head region composed of three colors: tip of head white followed by yellow/beige band (often faded) which is then followed by reddish brown band; white cephalic groove is small and thin, encircles head region, running through anterior of mouth; nuchal organs absent..... **Tubulanidae sp D**
- 13. Body with distinct rings or stripes, in addition to preservation band ..... 14
- Body with preservation band only, other combinations of rings and stripes absent .....  
..... 17
- 14. Longitudinal stripes absent; body red with white rings..... **Tubulanus albocinctus**
- Longitudinal stripes and rings present; background body color light or dark..... 15
- 15. Body darkly colored (red or brownish) with white rings and two dorsolateral and two lateral white stripes; head with pair of frontal pigment spots..... **Tubulanus cingulatus**
- Body light colored (cream, yellow, greenish) with black rings and longitudinal black stripes running length of body; paired frontal spots absent..... 16
- 16. Body with one dorsal and two lateral brown to black longitudinal stripes running length of body ..... **Tubulanus frenatus**
- Body with black rings and one dorsal black stripe running length of body .....  
..... **Tubulanus sp SD1**
- 17. Thin white band often present anterior or within preservation band (sometimes difficult to distinguish if color pattern poorly preserved); preservation band typically in esophageal region; LSO present within preservation band ..... 18
- White band absent, darker preservation band anterior to esophageal region ..... 19
- 18. Specimen often thread-like, thin and elongate; preservation band typically multi-colored, with the anterior portion of the preservation band light in color and quickly turning to dark red-purple, with dark red-purple spotted pattern continuing posteriorly  
..... **Tubulanus sp A**
- Specimen often robust, though immature specimens thin and elongate; preservation band typically brown, uniform color or with slight variation of yellow-brown to reddish brown, but not deep red-purple..... **Tubulanus polymorphus**

# Nemertea: Anopla

19. [Note 3 choices] CSO present, pit-like; LSO posterior to preservation band; lateral nerve chord imbedded within outer-circular muscle layer throughout body..... **Tubulanidae sp E**
- CSO absent; LSO within dark preservation band; lateral nerve chord outside of outer-circular muscle layer in esophageal region, but is imbedded within middle-longitudinal muscle layer in intestinal region, extension of circular muscle often encircling lateral nerve chord ..... **Carinomella lactea**
- CSO absent; LSO distinct; posterior to white band..... **Tubulanus polymorphus<sup>iv</sup>**
20. Cephalic slit present, distinct..... **(Lineidae)**.....21
- Cephalic slit absent, indistinct, or represented by shallow, oblique groove.....35
21. [Note 3 choices] Caudal cirrus present<sup>v</sup> (if not apparent, examine posterior tip for scar); body often dorso-ventrally flattened, at least towards posterior.....22
- Caudal cirrus absent, posterior end apically rounded, scar absent .....30
- Posterior end missing, presences/absence of cirrus indeterminable..... **Lineidae**
22. The presence or absence of neurochord cells cannot be verified; specimen small  $\leq 2$ –3mm width and without distinctive coloration ..... **Lineidae<sup>vi</sup>**
- The presence or absence of neurochord cells can be verified; specimen generally large,  $\geq 2$ –3mm width.....23
23. Neurochord cells absent; head anteriorly blunt, rounded; cephalic slit with rounded edges (generally  $\frac{1}{4}$  -  $\frac{1}{2}$  distance between anterior end and mouth); mouth typically small and circular, not noticeably musculature .....28
- Neurochord cells present; head anteriorly tapered, broadened, spatulate; cephalic slit deep, edges sharp (generally reaching or just short of mouth); mouth typically large and noticeably musculature (i.e., often with raised and/or ridged edges) ..... **(Cerebratulus)**.....24
24. Distinctive body color pattern absent, ground color beige, cream, or buff throughout, though lateral margins may be lighter in color.....25<sup>vii</sup>
- Distinctive body color pattern present.....26
25. Mouth large, elongated, with distinctly ribbed margin, especially along posterior edge; lateral margins of body gently rounded, not distinctly lighter in color; body coloration [according to Coe 1905] light to rosy flesh colored, cream or buff..... **Cerebratulus californiensis**
- Mouth smaller, rounded, margins smooth, not distinctly ribbed; lateral margins of body often tapered, distinctly lighter in color; body coloration [according to Coe 1905] black, brown, reddish-brown, olive or grey with lighter colored lateral margins ..... **Cerebratulus marginatus**
26. Body with many fine, irregular, dark longitudinal stripes of various lengths extending the entire length of the body, more numerous dorsally than ventrally ..... **Cerebratulus lineolatus**
- Body without stripes; anterior portion of head white relative to generally uniformly dark background .....27
27. Tip of head white, extending only partially along cephalic slits ..... **Cerebratulus montgomeryi**
- Anterior portion of head white, with white coloration extending posteriorly for most of the length (about three-fourths) of the cephalic slit ..... **Cerebratulus albifrons**



# Nemertea: Anopla

28. Body of generally uniform color (salmon, pale red, ochre, light brown or cream), sometimes lighter anteriorly towards head, often with medio-ventral white line; eyes absent..... *Maculaura alaskensis* **Cmplx**
- Body with distinctive pattern of stripes or with light colored head contrasted against dark background; eyes present ..... 29
29. [Note 3 choices] Head bordered anteriorly by a narrow terminal band of white, extending back along the borders of cephalic slits; white transverse line starting near posterior margin of cephalic slits and continuing ventrally, often surrounding the mouth; body coloration light brown, olive, yellow or beige ..... **Lineidae sp SD1**
- Head bordered anteriorly by a narrow terminal band of white, which extends back along the borders of cephalic slits, and can have a pair of dark spots dorsally in center of the white band); this white coloration of the head is contrasted against dark body background color ..... *Micrura wilsoni*
- Head lighter in color than body; body decorated with many spots fused into short longitudinal lines interrupted by transverse lighter bands..... *Micrura coei*
30. Tip of head same color as rest of body, though anterior margins may be light in color ..... 31
- Entire head or tip of head distinctly set off from body, often white or cream ..... 32
31. [Note 3 choices] Head with dorsal light patch (sometimes absent) extending as mid-dorsal white line posteriorly for length of animal; body background color often greenish to brown; eyes absent..... *Lineus bilineatus*
- Head without dorsal light patch; anterior margin of head pale or colorless; mid-dorsal white line absent; body background color often yellow to light brown; 3–7 irregular ocelli present, the most anterior pair the largers..... *Lineus flavescens*
- Head without dorsal light patch; body background color often dusky or brownish green, dark or reddish brown, often paler ventrally; eyes present in single row of 4–8 ocelli per side..... *Ramphigordius sanguineus*
32. Head pointed, set-off from body by distinctly lighter color, often sprinkled with red to orange spots; body with dark rings (inconspicuous in smaller specimens) and either darkly pigmented or pail with dorsal speckling; eyes absent; body often thick and massive ..... *Euborlasia nigocincta*
- Head rounded or squared; color pattern not as above; eyes present or absent ..... 33
33. Tip of head rounded, white, with white extending back about one-quarter the length of the cephalic slits, without pair of large crescent-shaped eyes or spots; body typically small (10–15mm), rounded anteriorly and slightly flattened posteriorly ..... *Lineus rubescens*
- Tip of head slightly squared and often with indentation, bearing a pair of large crescent-shaped eyes or spots ..... 34
34. Head with slightly indentation distally and two large, crescent-shaped eyes visible without clearing; head without pigment along anterior and lateral margins and body grayish-green to light red dorsally with crème ventrum, longitudinal lines absent ..... **Lineidae sp Hyp1**
- Head with or without indentation, eyes absent; tip of head white with two orange spots; body typically brown or slaty with narrow rings and 7–15 narrow longitudinally oriented lines, of which the middle is the most distinct..... *Lineus pictifrons*

# Nemertea: Anopla

35. Body with distinctive coloration; eyes present; epidermis very thick; proboscis 2-layered musculature (outer circular-inner longitudinal)..... (**Valenciidae**)....39
- Body generally without distinctive coloration, typically shades of beige, cream, or white; eyes absent.....36
36. Head anteriorly tapering, noticeably attenuated at tip.....37
- Head blunt or rounded anteriorly, not attenuated.....38
37. Head strongly tapered, often wrinkled from tip to mouth or strongly contracted; cephalic slit absent, a hint of furrow often present in form of white line; cerebral sense organ present, distinctive; body often white to cream; caudal cirrus present.....  
..... **Zygeupolia rubens**
- Head evenly tapering, laterally rounded, without cephalic slit, groove, or furrow; body smooth, beige, without distinct coloration, rounded throughout; caudal cirrus present..... **Heteronemertea sp Hyp2**
38. Cerebral sense organ represented by glistening C-shaped structure; mouth often puckered, extended outward; outer longitudinal muscle layer thin, equal to or thinner than middle circular layer; specimens small, often fragmented, though caudal cirrus absent in intact specimens ..... **Heteronemertea sp SD2**<sup>viii</sup>
- Cerebral sense organ represented by distinctive slit, sometime C-shaped structure; mouth not as above; outer longitudinal muscle layer relatively thick, 1.5 to 2 times thicker than middle circular layer; specimens elongated; caudal cirrus present in intact specimens..... **Heteronemertea sp Hyp1**
39. [**Note 4 choices**] Cephalic slit shallow; many small black ocelli present along the length of the cephalic slit; two transverse lines of brown pigment in anterior section; single longitudinal lines of brown present on each side..... **Lineidae sp A**<sup>ix</sup>
- Body with numerous longitudinal stripes (narrow black or brown lines), interrupted and irregularly anastomosing; eyes visible upon clearing.....  
..... **Baseodiscus delineatus**
- Body often thickened, yellow-ish, dotted with irregularly spaced, small, dark, red or brown spots or speckling that may coalesce to form broad patches; eyes visible upon clearing (6 – 10 eyes on each side of head)..... **Baseodiscus princeps**
- Body without distinctive stripes or spotting, head with broad, dark-colored spot that is bordered terminally and laterally by white (brown fades out with preservation (I have pics); with 40-60 eyes on each side of head..... **Baseodiscus punneti**



# Nemertea: Anopla

## ENDNOTES

---

- <sup>i</sup> Enoplans are not included in this key.
- <sup>ii</sup> *Zygeupolia rubens*, Heteronemertea sp Hyp1, Heteronemertea sp Hyp2, and Heteronemertea sp SD2 do not possess a distinctive horizontal cephalic slit. Instead it can be indicated by the presence of a white line or very shallow furrow. They can only be reliably separated from true Palaeonemertea by cross-section to determine the muscle-layer configuration.
- <sup>iii</sup> Some specimens that had been reported by SCB POTW agencies with this lateral nerve cord placement were entirely white, without coloration. The same condition was present in a Santa Barbara Museum of Natural History specimen identified by Coe; however that condition is contrary to published description of *Carinomella*, which uniformly list it as having a dark preservation band. Consequently, *Carinomella* is included in this key twice (see couplet 18): one where a preservation band is present and one where it is not.
- <sup>iv</sup> *Tubulanus polymorphus* comes in many variations in the color pattern. Sometimes the preservation band, typically occurring in the esophageal region, posterior to the white ring, can occur anterior to it. This form may represent a different species, but to date there is no strong reason or character state other than this color to compel the creation of a separate species.
- <sup>v</sup> The cirrus of *Micrura wilsoni* and *Zygeupolia rubens* can be very small, per Coe 1904. Contrast this to the rounded end of a true *Lineus*, *Euborlasia* or *Ramphigordius* (both of the latter formally within the genus *Lineus*).
- <sup>vi</sup> Specimens with distinct coloration may be identifiable even if presence/absence of neurocord cells cannot be confirmed.
- <sup>vii</sup> *Cerebratulus marginatus* and *C. californiensis* cannot be reliably separated as collected in most benthic grabs; however, some members of the SCB taxonomic community rely on the character states of the mouth and lateral margins of the body as indicated in couplet 25 to speciate them. DP has recently found these characters to be less reliable. He has found specimens with large, muscular mouths and narrowed, lightly colored lateral margins, contrary to the paired characters of the couplet. DP has also samples with both species represented, according to mouth and lateral margin character states. Coe 1905 distinguishes the two species based upon color [in preservation]: *C. marginatus* is distinguished in being black, brown, reddish-brown, olive or gray and having lighter colored, narrowed lateral margins, versus *C. californiensis* with body lighter in color, rosy flesh color, cream or buff with the intestinal region cream or buff colored.
- <sup>viii</sup> There is some doubt about whether Heteronemertea SD2 and Heteronemertea sp Hyp1 can be reliably separated (See discussion in SCAMIT NL 32, No. 5); however, the characters used in this key are believed to be reliable.
- <sup>ix</sup> Lineidae sp A was described by C. Paquette from Goleta, CA samples on three occasions. The posterior end is unknown because all specimens were represented by anterior fragments. I've included the provisional species with the Valenciniidae because Carol references a "cephalic slit shallow, with many small black ocelli" in her provisional voucher sheet, characteristics commonly associated with members of this family.