I. **Lophotrochozoa** clade includes the following phyla that we will cover:

1. Ectoprocta (or Bryozoa; clade)
2. Platyhelminthes (clade?)
3. Rotifera (clade)
4. Annelida (clade)
5. Nemertea (clade)
6. Brachiopoda (clade?)
7. Phoronida (clade)
8. Mollusca (clade) will be covered in Topic 13

II. **Phylum Ectoprocta** (bryozoans, or moss animals)

a) ~4500 living species

b) coelomate

c) aquatic, mostly marine

d) use lophophore for feeding

e) secrete and live in a chitinous chamber (**zoecium**); also may be reinforced with calcium carbonate

f) adults are sessile and colonial; communicate chemically through pores in zoecia

g) some non-protostome characteristics: radial cleavage, secondary mouth, deuterostome-style coelom

h) appear to be a sister group to rest of the lophotrochozoans

III. **Phylum Platyhelminthes** – the flatworms (must exclude Acoelomorpha to have any hope of having a grade or clade)
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a) ~20,000 living species

b) acoelomate

c) ribbon-shaped, soft-bodied, flattened

d) most are parasitic, some are scavengers and carnivores

e) non-parasitic forms far more active than cnidarians or ctenophores

f) those with a digestive cavity have an incomplete gut (only one opening)

g) excretory system - small tubules lined with ciliated flame cells (move water and waste into tubules and out of body)

h) no circulatory system – oxygen and food must diffuse to all cells

i) some have nerve cords and simple central nervous system

j) reproduction

1. most are hermaphroditic

2. most have internal fertilization: each partner deposits sperm in the other’s copulatory sac

3. asexual regeneration also possible in many

k) three classes to learn (we’ll leave out the 4th class, Monogenea)

l) Class Turbellaria (grade)

1. only free-living flatworms

2. use ciliated epithelial cells for movement

3. have eyespots; usually move away from light

4. have sensory pits or tentacles for detecting food, chemicals, and nearby movement

5. use pharynx (muscular throat) in feeding

6. abundant in many aqueous environments

7. some occur in moist terrestrial areas

8. include planaria

m) Class Trematoda (clade) – flukes

1. all parasitic; resistant to digestive enzymes and host immune responses
2. use mouth to feed
3. 1 mm to 8 cm long
4. attach via suckers, anchors or hooks
5. usually have two or more hosts (larvae almost always in snails, final host almost always a vertebrate)
6. important pathogens of humans:
   - human liver fluke
     - inhabit bile passages in the liver of humans, cats, dogs, and pigs
     - can get them from eating raw fish
     - can cause cirrhosis and death in high infestations
   - blood flukes of genus *Schistosoma* afflict 5% of world’s human population and cause schistosomiasis (kills \(\sim\)800,000 each year)

n) **Class Cestoda** (clade) – tapeworms

1. all parasitic; resistant to digestive enzymes and host immune responses
2. absorb food through skin (no mouth, no digestive tract or digestive enzymes)
3. **scolex** - attachment organ with several suckers and possibly also hooks
4. **neck** – unsegmented; connects scolex to proglottids
5. **proglottids** - complete hermaphroditic units, making sperm and eggs
   - older ones further from neck have mature, fertilized eggs,
   - embryos develop and fill proglottid
   - proglottids shed through feces and deposited for some other animal to pickup
6. human pathogen – beef tapeworm
   - juvenile intermuscular parasite on cows
   - frequent parasite of humans, can get from eating rare beef
   - adult in intestines of humans - to 10 m+!
   - 1% of cattle in U.S. are infected - don't eat rare beef!
IV. **Phylum Rotifera** – rotifers

a) ~1800 species;

b) pseudocoelmate

c) common, small (most <1 mm), mainly aquatic animals

d) mostly free-living and found in freshwater environments; some are parasites; some terrestrial

e) **corona** - ciliated, food-gathering organ at tip of head (filter-feeders)

f) sometimes called “wheel animals” because of appearance of beating cilia

g) true digestive tract with separate mouth and anus

h) jaws in **pharynx**

i) hydrostatic skeleton with rudimentary circulatory system

j) separate sexes; some species with **parthenogenesis** – development of unfertilized eggs

k) appear to group with true Platyhelminthes and others in a clade called Platyzoa

V. **Phylum Annelida** – segmented worms

a) ~16,500 species in marine, freshwater and terrestrial systems

b) coelomate

c) includes polychaetes, earthworms, and leeches

d) unquestionably segmented

1. repeated segments visible as rings

2. segments separated by partitions called **septa**

3. each segment has its own coelom

4. fluid inside coelom of each acts as a **hydrostatic skeleton**

5. muscles push against the fluid, expanding and contracting (each segment acts independently)
6. anterior segments often modified as heads, with sense organs, a brain, and even some with eyes

7. some segments modified as copulatory organs

8. connections between segments
   - nervous system via ventral nerve cord
   - circulatory system blood vessels (closed circulatory system)
   - digestive tract with separate mouth and anus

  e) most have setae – bristles of chitin used to anchor the worm to a substrate
     (“bristleworms“)

  f) closed circulatory system has some enlarged vessels that serve as hearts

  g) gases are exchanged at skin (no gills or lungs)

  h) excretory system includes nephridia (like in mollusks)
     1. 2 per segment
     2. transport waste out of coelom by excretory tubules

  i) 3 classes: Polychaeta (polychaetes), Oligochaeta (earthworms), and Hirudinea (leeches)

  j) **Class Polychaeta** (grade) – polychaetes
     1. many unusual and colorful forms; include plumed worms, peacock worms, fan worms, and many others
     2. ~10,000 living species, mostly marine
     3. often live in burrows
     4. usually filter-feeders, sometimes carnivores or parasites
     5. distinctive characteristics:
        - typically more cephalized than other annelids
        - **parapodia** - paired, fleshy, paddle-like flaps on most segments- used for moving and gas exchange
6. sexes separate, but usually lack permanent gonads (sex organs); instead, make gametes from cells lining coelom or septa

7. external fertilization

8. trochophore larvae – similar to that of mollusks (ciliated)

k) **Class (or subclass) Oligochaeta** (grade) – earthworms

1. mostly terrestrial (in moist soil); a few aquatic species
2. eat their way through soil (usually eat own weight in soil each day; most soil has passed many times through worm guts)
3. 100-175 segments, with mouth on first one and anus on last one
4. no eyes, but some light-sensitive organs near end of body
5. reproduction
   a. **hermaphroditic**
   b. join in opposite directions at the clitellum (obvious thickened band), which secretes mucus that holds the pair together during copulation
   c. exchange sperm, and then each lays eggs in mucous cocoon surrounded by chitin that is secreted by the clitellum (this cocoon protects the fertilized eggs)

l) **Class (or subclass) Hirudinea** (clade) – leeches

1. mostly freshwater species; some marine, some terrestrial
2. hermaphroditic with clitellum (only during breeding season)
3. reduced segmentation (34 segments), and coelom is reduced and continuous (septae lost)
4. usually dorsoventrally flattened (resemble flatworms)
5. all but one species have no setae
6. have suckers at one or both ends of body
7. includes parasites, predators, and scavengers
8. many suck blood (external blood-sucking parasites)
   a. chitinous jaws used to rasp through skin
produce an anticoagulant to keep blood flowing

once again being used by doctors to drain blood

9. form a clade with Oligochaeta that is sometimes called class (or superclass) Clitellata

VI. Phylum Nemertea – the ribbon worms or proboscis worms
   a) ~ 900 living species; mostly marine
   b) partially coelomate/partially acoelomate
   c) similar to free-living flatworms
   d) often large (up to many meters)
   e) proboscis – long muscular tube covered by a sheath, thrust out quickly to capture prey
   f) excretory and nervous systems similar to flatworms
   g) complete digestive system (two openings, mouth and anus)
   h) closed circulatory system (blood vessels)

VII. Phylum Phoronida – horseshoe worms
   a) 20 living species
   b) coelomate
   c) marine; many burrow into sea bed
   d) use lophophore for feeding
   e) U-shaped gut; secrete and live within a chitinous tube

VIII. Phylum Brachiopoda
   a) 335 living species
   b) brachiopod “clams” – have two calcified shells, superficial resemblance to clams
   c) most are anchored via a unique stalk
   d) were very common and diverse in the Paleozoic
   e) decimated in the “Great Dying” (end Permian mass extinction event ~250 mya)
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f) form a clade with Phoronida