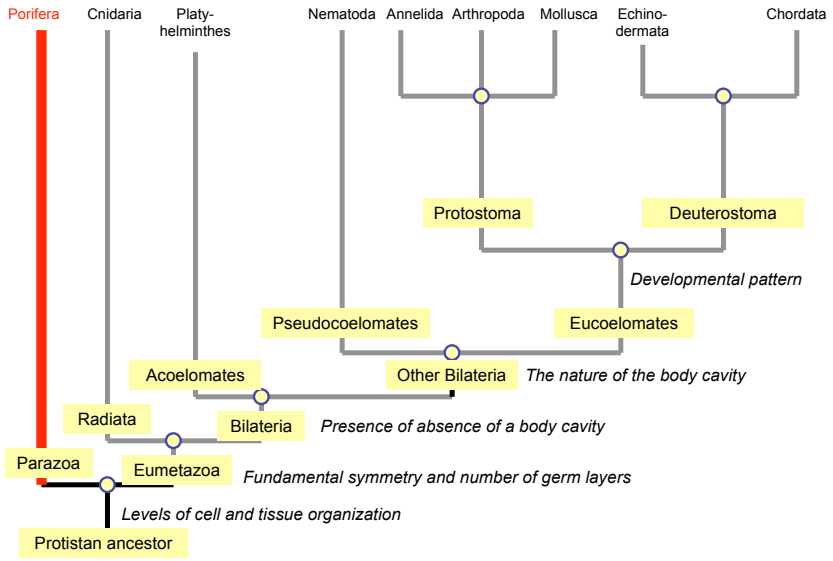
The simplest of metazoan phyla: *'Parazoa'*



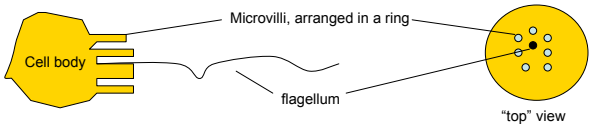
The simplest of metazoan phyla: *'Parazoa'*

Sponges: phylum Porifera ('hole-bearers')

Called 'Parazoa' ("besides the animals") because they are so simple. About 15,000 species, marine and freshwater. Basically a 3-D sieve through which water is pumped.

Fundamental characteristics are:

- **Cellular** grade of organization (no true tissues)
- sessile (no movement, attached to substrate; larvae motile)
- little apparent symmetry
- supporting 'skeleton' of mineralized **spicules** (SiO_2, $CaCO_3$) or a protein secretion (**spongin**) or both
- a specialized an unique cell type, choanocytes ('collar cells'):



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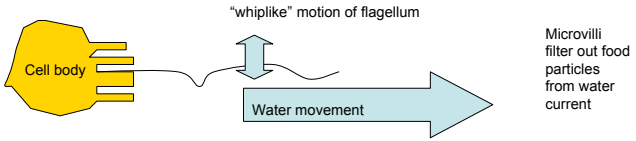


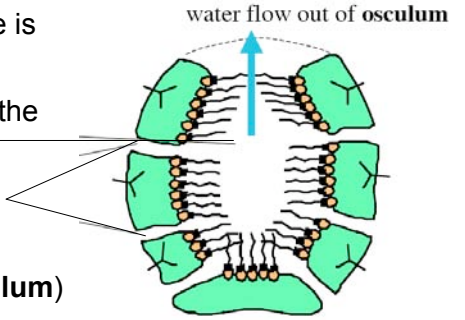
The simplest of metazoan phyla: *'Parazoa'*

Sponge body plans are small pumping chamber lined with, and powered by, choanocytes. The animal pumps water through the perforated body wall and out of an excurrent pore; food particles in the water are filtered out and absorbed.

- choanocytes pump with flagellae, so chambers cannot be too large (or flagellae would only stir a thin layer of water)
- to become larger, sponges add more chambers

Simplest sponge grade is **Ascon**:

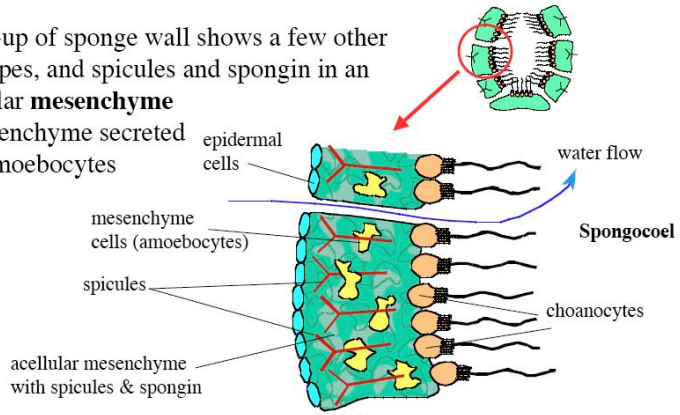
- one chamber, called the **spongocoel**
- walls perforated with incurrent pores
- excurrent pore (**osculum**)



The simplest of metazoan phyla: *'Parazoa'*

Close-up of sponge wall shows a few other cell types, and spicules and spongin in an acellular **mesenchyme**

- mesenchyme secreted by amoebocytes

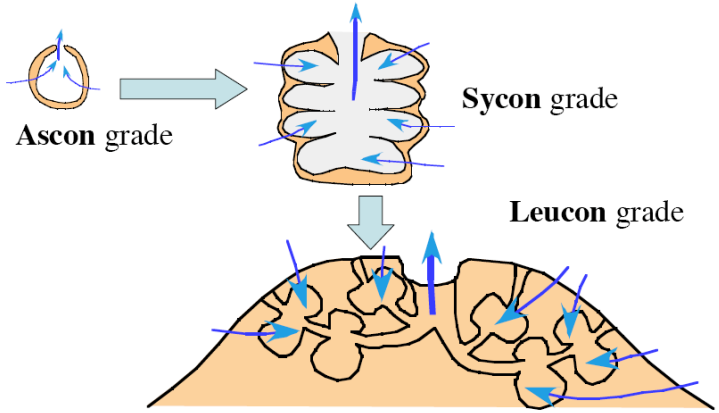


- sponges are very loosely organized, little or no coordination
- can be mechanically or chemically broken down and can reform!
- cells are **totipotent** -- single cell of any type can form new animal

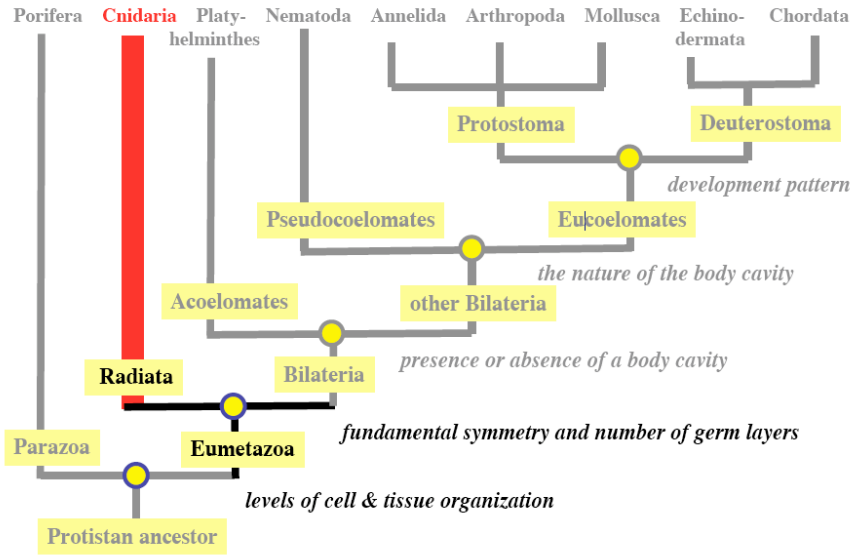
The simplest of the metazoan phyla: *'Parazoa'*

Ascon sponges are small. Two larger grades are **Sycon** and **Leucon.** These are basically amalgamated ascon 'units.'

- because each spongocoel remains small, pumping remains effective even if complete animal is big:



All other metazoans are separated from Porifera by **more complex body form.** The first of these are the **Cnidarians (Radiata).**



Diploblastic animals

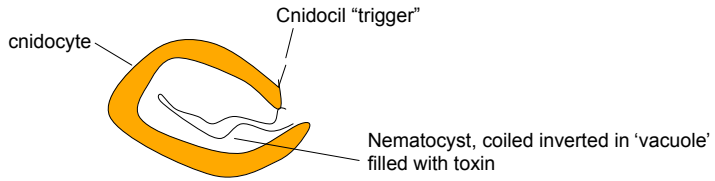
CNIDARIANS: phylum Cnidaria ("thread-bearers")

About 9,000 species, most in marine habitats (a few in fresh water)

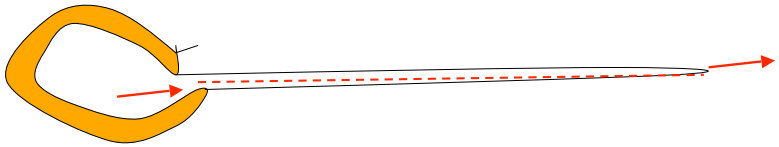
- **TISSUE** level of organization: cells are organized into specialized tissues, sometimes approaching organs (groups of different tissues with common function)
- DIPLOBLASTIC --two fundamental cell layers
- **Radial symmetry** around the **oral-aboral axis**.
- Support via **hydrostatic skeleton** (trapped water) or **viscoelastic skeleton**.
  - Hydrostatic: deformable but not compressible
  - Viscoelastic: deformable but "springy" (elastic), not compressible
- Sessile and attached, or floating in water -- some swim fairly actively (have contractile "muscle" cells, but these don't derive from mesoderm)

Diploblastic animals

Cnidarians have their own characteristic and unique cell type, the cnidocyte. Cnidocytes are stinging cells with a special organelle, the nematocyst.

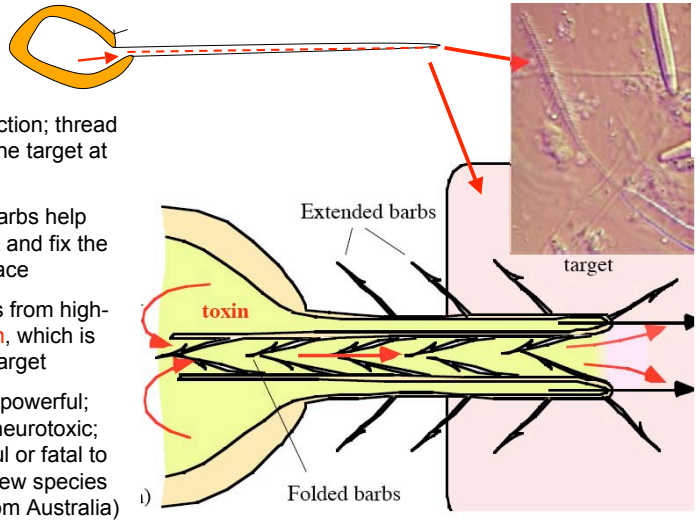


When the cnidocil trigger is touched, or if certain chemicals are present, the nematocyst discharges by rapidly inverting outwards under pressure:



Diploblastic animals

A closer look at a discharging nematocyst shows sophisticated mechanism:



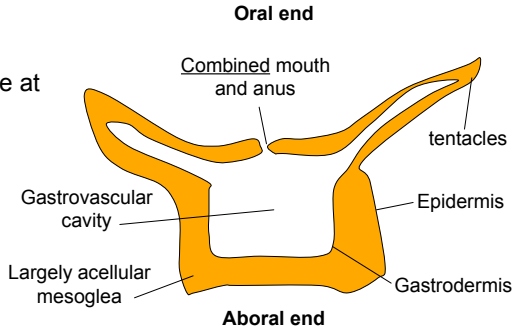
- ***Rapid*** projection; thread is 'fired' into the target at high speed
- numerous barbs help dig into target and fix the thread into place
- propulsion is from high-pressure toxin, which is injected into target
- can be very powerful; hemolytic or neurotoxic; may be painful or fatal to humans in a few species (box jellies from Australia)

Diploblastic animals

Cnidarians have two basic body forms, which are quite similar. Both built around two cell layers and **hydrostatic** or **viscoelastic** skeleton.

Polyp form

- sessile, attached to substrate at aboral end
- if mouth is closed, water is trapped in the gastrovascular cavity
- circular and longitudinal 'muscles' put pressure on trapped water



- tentacles catch food; simple nerve net and some coordination

Diploblastic animals

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- Water is *deformable* but *not compressible* -- basis of **hydrostatic** skeleton (can change **shape** but not volume) -- **gastrovascular cavity** works this way.
- A **viscoelastic** skeleton is *deformable and noncompressible* -- but it is also elastic and resumes original 'relaxed' shape when force is removed (it is 'springy') -- **mesoglea** works this way.

Diploblastic animals

Cnidarians have two basic body forms, which are quite similar. Both built around two cell layers and **hydrostatic** or **viscoelastic** skeleton.

Polyp form

Even these very simple animals have **social behavior**: in some species, clonal colonies form by asexual division, and fight territorial battles with other clone groups.

cavity

• circular and longitudinal 'muscles' put pressure on trapped water

• tentacles catch food; simple nerve net and some coordination

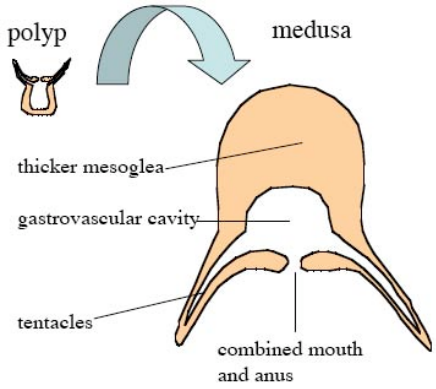
Diploblastic animals

The other basic cnidarian body form is the free-swimming **medusa**, obtained by 'flipping over' the polyp:

• swims by contracting muscles around gastrovascular cavity, pushing against water

• springy (viscoelastic) mesoglea helps sustain rhythmic swimming

• tentacles may be very long



Diploblastic animals

Three major classes of cnidarians:

Hydrazoa (hydra, etc.)

• Complex life cycle, always with polyp form; sometimes medusa

• **Polyp** is the 'dominant' stage.

• Sometimes colonial with many specialized individuals (**clones**) form the complete 'animal' ("Portugese man-o-war").

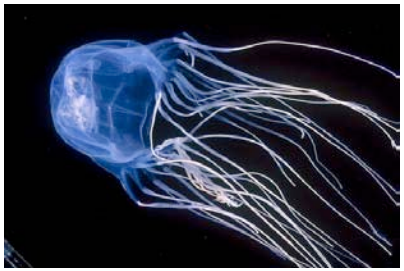
Diploblastic animals

Three major classes of cnidarians:

Schphozoa (“true” jellyfish); free-swimming

Complex life cycle, medusa stage is dominant; feed on animals.

Some can get very large (over a meter in diameter).



Diploblastic animals

Three major classes of cnidarians:

Anthozoa (sea anemones and corals)

• only have the polyp stage; can be structurally fairly complex; mesoglea more cellular than in Hydrozoans and Scyphozoans

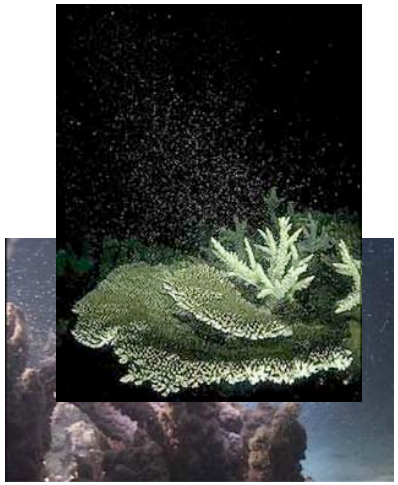
• often symbiotic with unicellular algae

• corals secrete a calcium carbonate “house”; coral reefs are largest structures made by any form of life

Diploblastic animals

Three major classes of cnidarians:

Reef corals reproduce sexually by spawning; simultaneous release of sperm and eggs on just one to three nights per year! This is their dispersal stage:



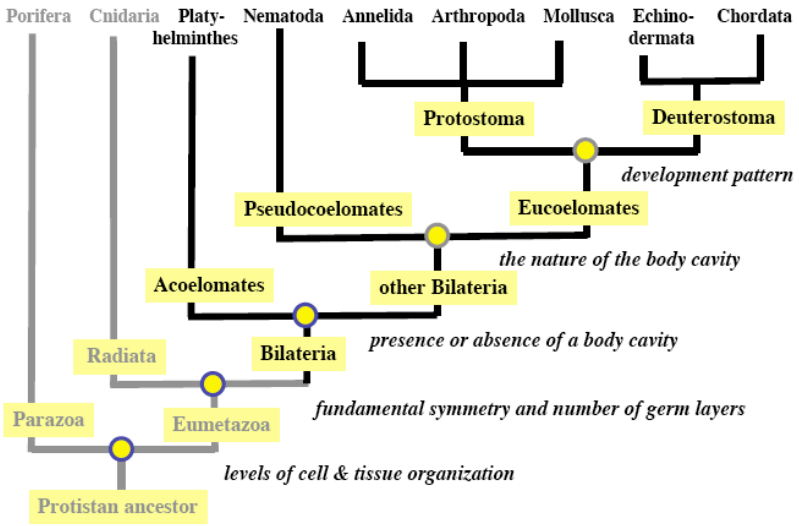
Next: groups with *three* fundamental cell layers and bilateral symmetry: triploblastic animals

Triploblastic animals have a third primordial cell layer, mesoderm, and tissues are compounded into **organs and organs systems**. Also, all triploblastic animals have a fundamental bilateral symmetry (not radial symmetry); often called ‘**bilaterians**’ or **Bilateria**. Within bilaterians, major clades (lineages) are defined by

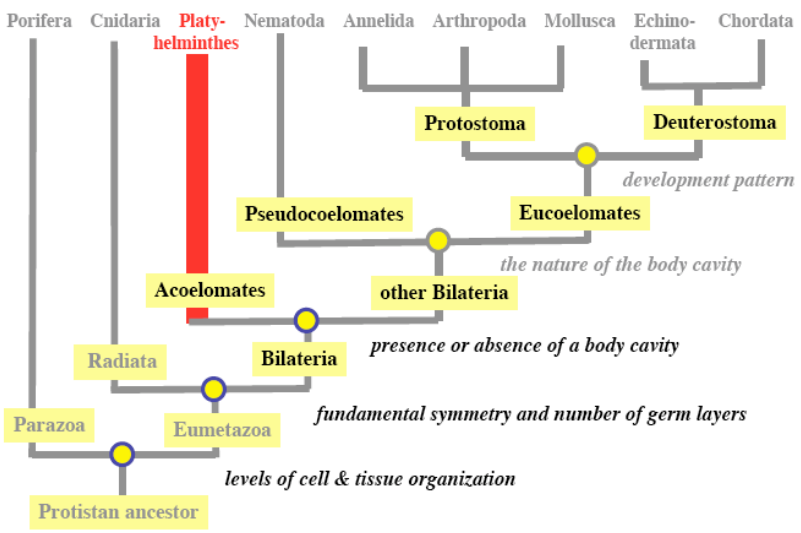
• changes in **body cavities** (presence, arrangement)

• patterns of **development** (especially how mesoderm and body cavities are formed)

Next: groups with *three* fundamental cell layers and bilateral symmetry: triploblastic animals



Next: groups with *three* fundamental cell layers and bilateral symmetry: triploblastic animals…first the **flatworms**, or **Platyhelminthes**



Triploblastic animals

FLATWORMS: phylum Platyhelminthes

15,000-20,000 species, in most habitats (marine, freshwater, moist terrestrial, often parasitic). Major characteristics:

All of the fundamental bilaterian traits:

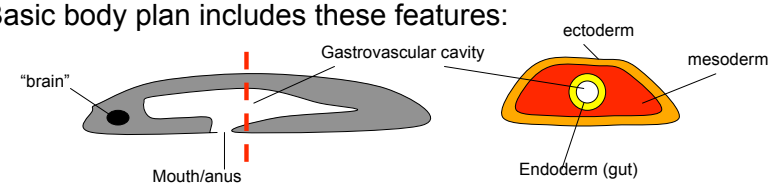
TRIPLOBLASTIC, ORGAN and ORGAN SYSTEM level of organization, BILATERAL SYMMETRY

- body solid (no cavities: ACOELOMATE
- **motile** (except some parasitic forms); mesoderm provides muscle tissue and improved locomotion compared to diploblasts
- hence *cephalized*
- no circulatory system (animal must be thin so diffusion will work)
- **Flat** (see above)

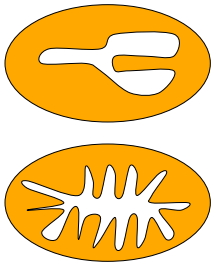
Triploblastic animals

FLATWORMS: phylum Platyhelminthes

Basic body plan includes these features:



- gut with **single opening**, usually branched to get close to all parts of body
- gut serves for **digestion, nutrition, gas exchange, waste removal**
- feed on animal tissue (scavenger, predator, parasite)
- often **hermaphroditic**: contains both male and female gonads; usually cross-fertilize

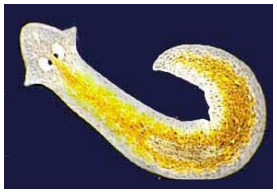


Triploblastic animals

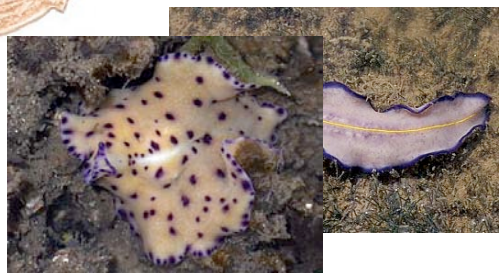
FLATWORMS: phylum Platyhelminthes

Three major classes:

Turbellaria (free-living flatworms), relatively unspecialized; probably similar to ancenstral flatworms. "Planarians" are familiar examples.



Other turbellaria live in marine habitats (like these):



Triploblastic animals

FLATWORMS: phylum Platyhelminthes

Three major classes:

Trematoda (flukes): *parasitic* and modified for this life style with a ventral and oral adhesive disc.

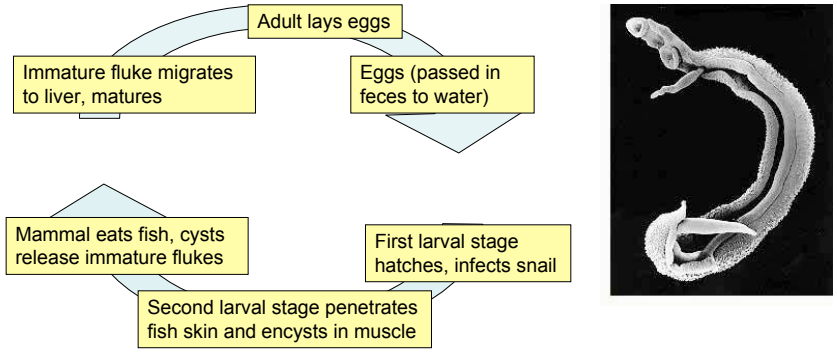
- Apparently ancestral forms were primarily parasites of molluscs (like snails), with subsequent evolution of other hosts, especially vertebrates
- Very diverse and often highly specialized (typical of parasites; **co-evolution** of host and parasite)
- Life cycles frequently complex, with multiple host species (at least one life stage is usually a mollusc).

Triploblastic animals

FLATWORMS: phylum Platyhelminthes

Examples of trematode life cycles

• *Clonorchis* (liver fluke) lives in liver and bile ducts of mammals (including humans); its life cycle passes from snails to fish to mammals:

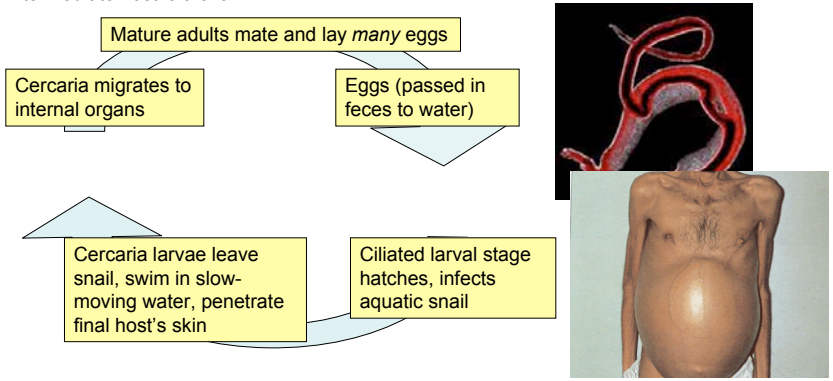


Triploblastic animals

FLATWORMS: phylum Platyhelminthes

Examples of trematode life cycles

• *Schistosoma* (cause of schistosomiasis) lives in blood vessels in intestine, bladder, etc. A major human disease problem in the tropics; sometimes called 'snail fever' because intermediate host is a snail:



FLATWORMS: phylum Platyhelminthes

Examples of trematode life cycles

• *Leucochloridium* is a parasite of birds and amber snails. It lives in the bird's gut; eggs are excreted in droppings, and snails eat them. In the snail, *Leucochloridium* produces large larvae-containing sacs that penetrate the snail's tentacles….and **pulsate** to attract birds!!

Triploblastic animals

Typical mature tapeworm (from humans, other mammals, birds) -- can be 3-4 meters long

Triploblastic animals

FLATWORMS: phylum Platyhelminthes

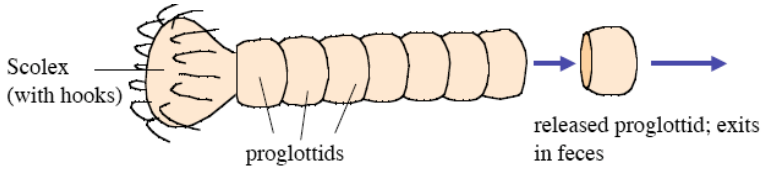
Third major class is **Cestoda** (tapeworms)

• Parasites of vertebrates, most highly specialized flatworms; one or more intermediate hosts

• no gut; all nutrition absorbed from host

• 'head' modified as a holding organ (**scolex**), attaches to host's gut lining (animal resides inside intestinal lumen).

• almost all of body is devoted to reproductive units called **proglottids**



• some tapeworms are harmful but many are co-evolved with hosts and do little damage