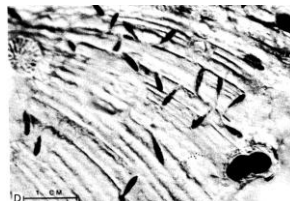
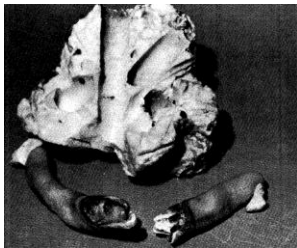
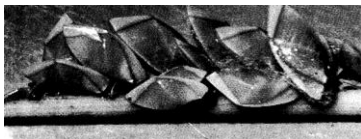
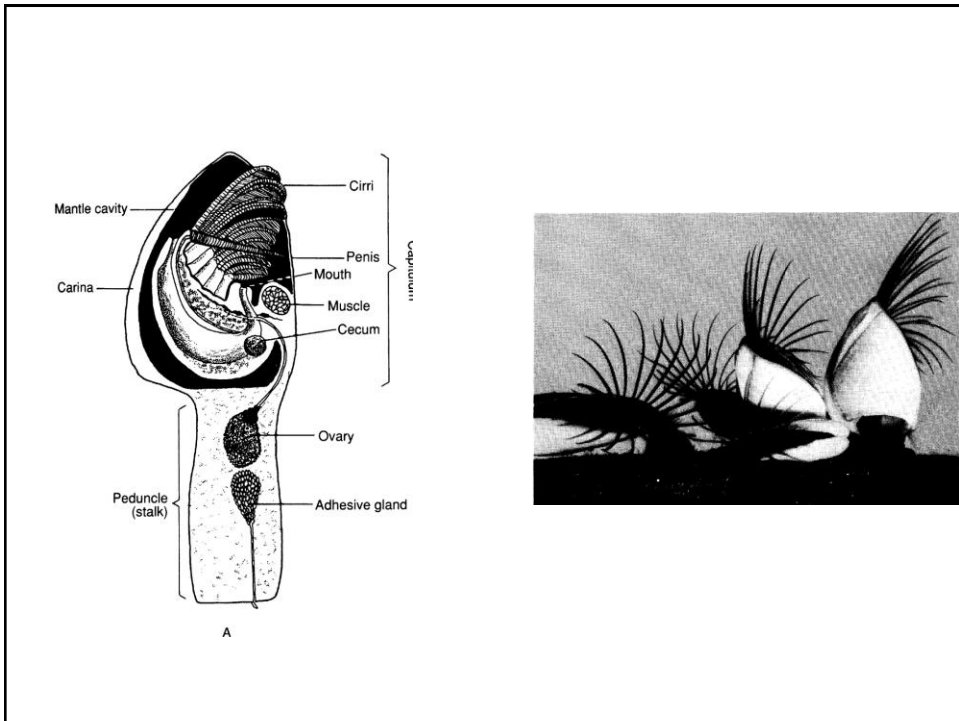
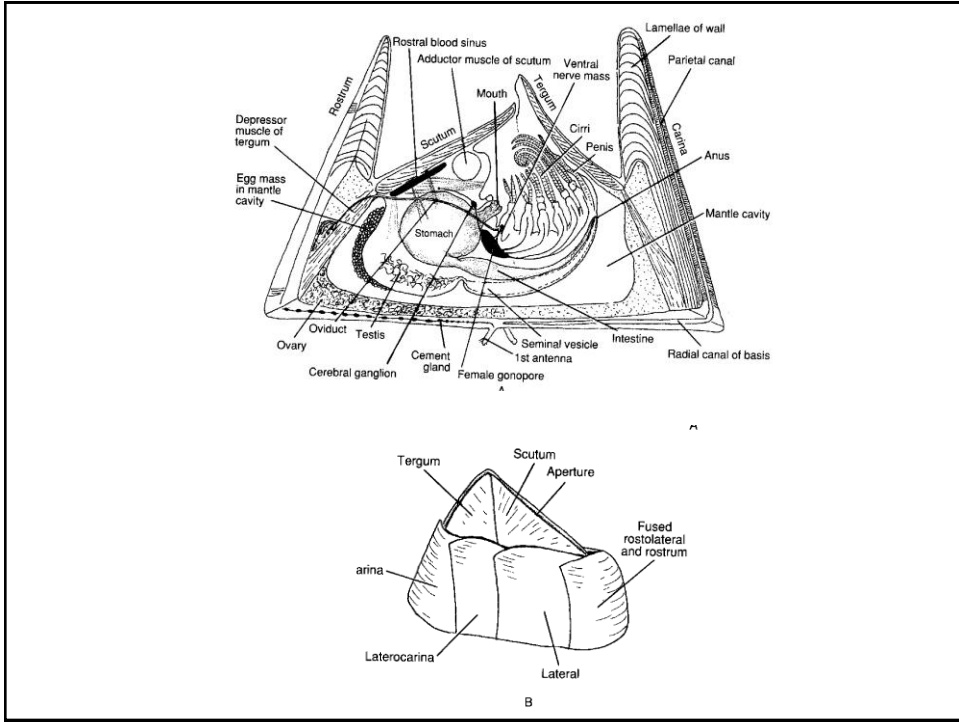
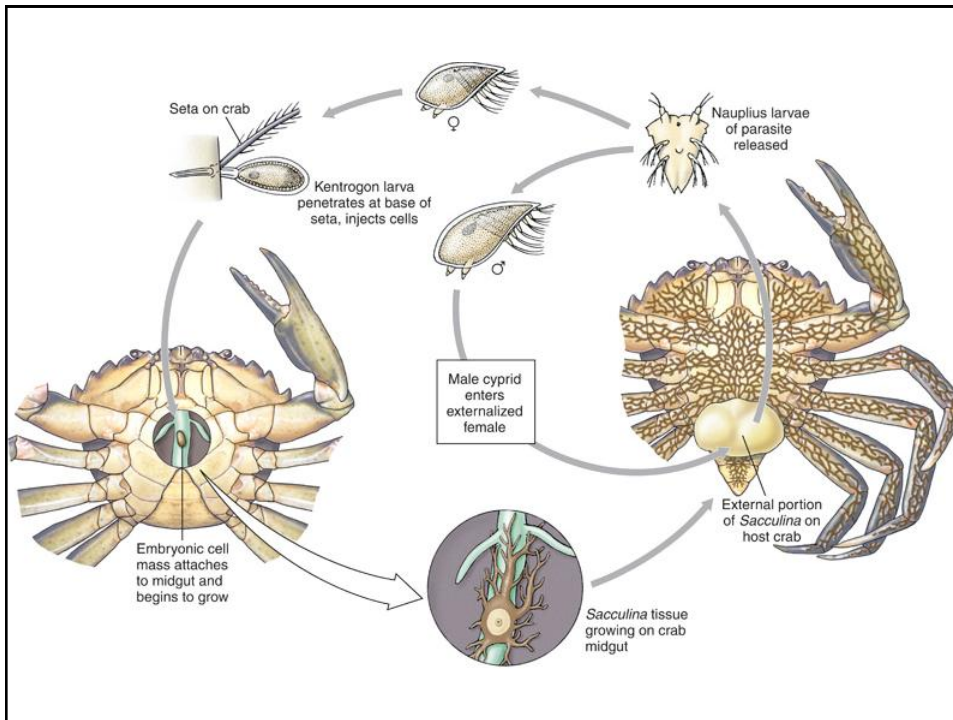


Subclass: Cirripedia

- 1) Order Thoracica: → **barnacles** 3 Orders: → burrowing or parasitic
- 2) sessile
- 3) attach directly (acorn barnacles) or by a stalk (goose barnacles)
- 4) carapace surrounds the body and secretes a set of **calcareous plates**
- 5) general structure
 - a) reduced head
 - b) **no abdomen**
 - c) **thoracic legs are long with hair-like setae**
many-jointed **cirri** with setae extend from plates to feed on small particles
- 6) ecology
 - a) filter feeders
 - b) problems of desiccation during low tides: plates close
- 7) reproduction & development
 - a) hermaphroditic
 - b) metamorphosis during development
 - 1) **nauplii**
 - 2) **cyprid** larvae with a bivalve carapace & compound eyes
attach to the substrate by their first antennae and adhesive glands
secrete calcareous plates, lose eyes & change swimming appendages to filtering cirri
 - c) **parasitic** forms: **kentrogon stage** injects cells into host hemocoel







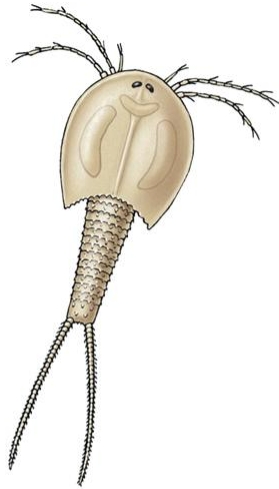
Class Branchiopoda

flattened & leaf-like legs: chief respiratory organs

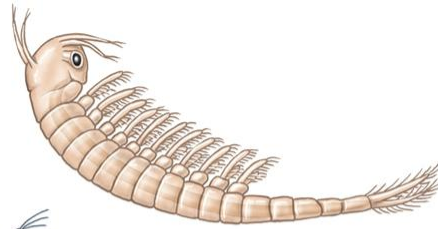
4 orders >10,000 species most freshwater

- I. Order Anostraca: lack a carapace legs suspension feeding
fairly shrimp & brine shrimp gradual metamorphosis
- II. Order Notostraca: carapace forms large dorsal shield legs suspension feeding
tadpole shrimp gradual metamorphosis
- III. Order Conchostraca: bivalved carapace legs suspension feeding
clam shrimp gradual metamorphosis
- IV. Order Cladocera: carapace encloses only body but not head
water fleas
mostly direct development
important part of freshwater zooplankton
legs function locomotion
parthenogenesis: reproduction without males
rapidly boost summer populations;
sexual reproduction with onset of unfavorable conditions
fertilized eggs highly resistant to cold → critical for winter survival

Branchiopods



A Tadpole shrimp
(order Notostraca)



B Fairy shrimp
(order Anostraca)



C *Daphnia*
(order Diplostraca,
suborder Cladocera)

Diversity of Reproduction

1) monoecious

barnacles but generally cross-fertilize

2) parthenogenesis (reproduction without males)

ostracods: males scarce

3) dioecious

brood eggs:

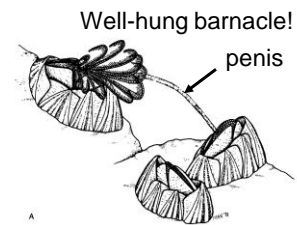
in brood chambers

in brood sacs attached to abdomen

attached to abdominal appendages

4) direct development without larval form

crayfishes



Crustacean Development

I. larva unlike the adult in form

A. nauplius

1) appendages/somites added → series of molts

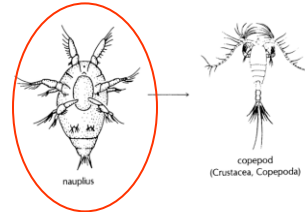
a) uniramous first antennae

b) biramous second antennae

c) mandibles

feeble swimming

B. adult

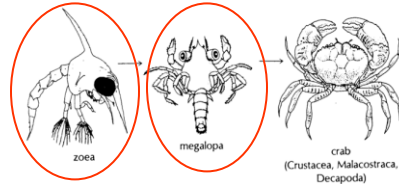


II. larva + juvenile stage → adult

A. nauplius → zoea

B. juvenile stage → megalopa

C. adult

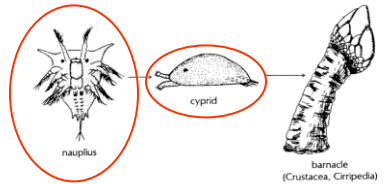


III. larva → 2nd distinct larva → adult

A. free-swimming nauplius

B. cyprid larva with bivalve carapace

C. sessile adult with plates



Artemia Larval Development

15 - 20 hours in seawater cyst shell breaks

1) **pre-nauplius in E-1 stage**

embryo hangs beneath cyst shell → umbrella stage

newly hatched pre-nauplius mouth & anus not fully developed:
yolk sac for nutrients

2) **pre-nauplius E-2 stage**

3) free-swimming nauplius → **Instar 1** nauplius

specialty modified antennae for locomotion & later for food filtering

4) ~12 hours posthatch molts into second larval stage (**Instar II**)

filter feeding on microalgae, bacteria & detritus

5) nauplius can live on yolk & stored reserves for up to 5 days
or through the **Instar V stage**

6) nauplius progresses through 15 molts → adult ~ 8 days.



300µm

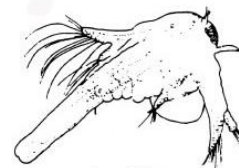
Pre-nauplius in E-1 stage



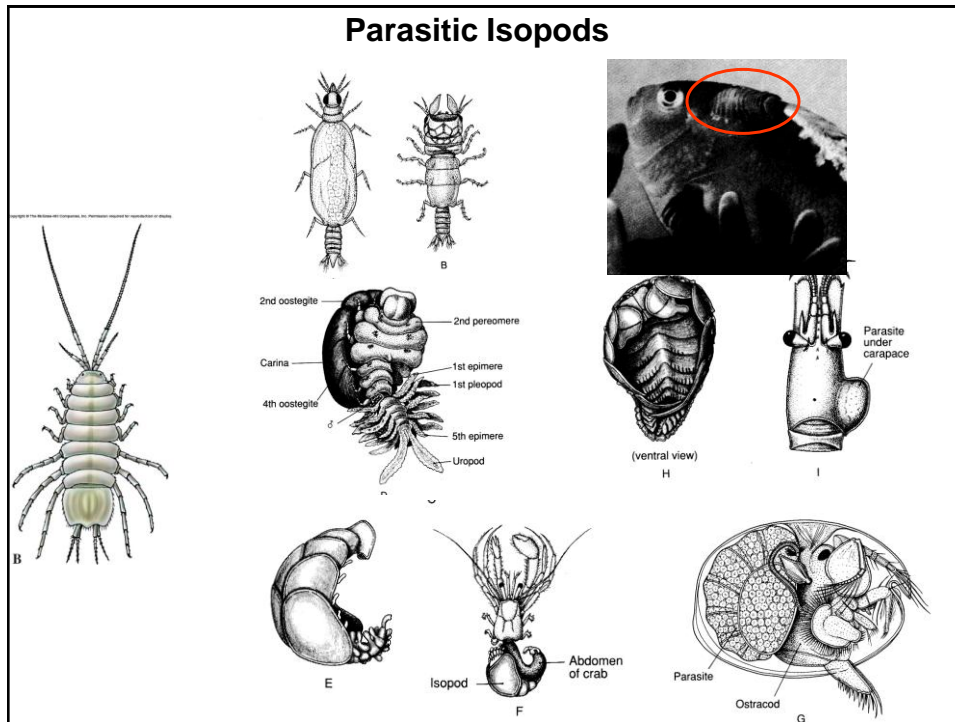
Pre-nauplius in E-2 stage



Freshly hatched Instar 1 nauplius



Instar V larva



Class Maxillopoda

Subclass: Copepoda

- 1) anterior, appendage-bearing portion of the body
 - a) antennules often longer than other appendages
 - b) lack a carapace & retain simple, median, nauplius eye in the adult
 - c) 1 pair of uniramous maxillipeds
 - d) 4 pairs flattened, biramous, thoracic swimming appendages
- 2) major joint separates anterior from posterior portion
- 3) ecology
 - a) free-living dominant consumer
 - marine plankton: *Calanus*: most abundant biomass in zooplankton
 - freshwater plankton: *Cyclops* & *Diaptomus*
 - b) free-living intermediate hosts
 - human parasitic tapeworms & nematodes
 - c) parasitic forms highly modified & reduced, often unrecognizable
- 4) development
 - a) indirect development
 - b) unusual metamorphoses in some highly modified parasites

Parasitic Copepods

