Chapter 33 Protostome animals

BLY 122 **A. Hunter from C. S. Major**

I. Why Do Biologists Study Protostomes?

A. Protostomes are the most abundant animals on Earth. (**Fig. 33.2**)
1. Protostomes are present in almost all habitats.
2. Protostomes are some of the most important model organisms in biology.

B. Crustaceans and Mollusks Are Dominant Animals in Marine Ecosystems
1. Crustacean and mollusk harvest is big business.
a. Shrimp, crabs, lobster, oysters, squid, and mussels are popular seafood delicacies.
b. Many are caught in the wild, so seafood companies consult biologists about the animals' life cycles, reproductive habits, and so on.
2. Crustaceans & mollusks - consumers, predators, & scavengers in marine food chains.

C. Insects, Spiders, and Mites Are Dominant Animals in Terrestrial Environments
1. Entomologists study insects in order to develop strategies for controlling their predation on human food supplies.
2. Insects & spiders important consumers, scavengers, & predators in terrestrial habitats.
a. Most angiosperms are pollinated by insects.
b. Insects and spiders are food for many predators higher in the food chain.

II. How Do Biologists Study Protostomes?

A. Research has drawn several general conclusions about the protostome lineage.
1. All protostome embryos experience similar embryonic development:
a. They have a spiral cleavage pattern.
b. They develop a mouth from the initial invagination during gastrulation.
c. If a coelom develops, it does so within blocks of mesoderm.
2. All protostomes are triplobastic bilaterally symmetrical with a head region that faces the environment.
3. Certain protostomes have segmented bodies.
4. The first fossil protostomes identified to date are 525–515 million years old.
5. Protostomes are a monophyletic group with two branching lineages—Lophotrochozoa and Ecdysozoa. (Fig 33.3)

B. Biologists analyze morphology traits to understand the diversification of protostomes.
1. Changes in coelom formation.
a. Protostome ancestors were coelomate.
(1) Most modern protostomes have a tube-within-a-tube body design with a well-developed coelom.
(2) In these species the coelom forms a hydroskeleton that facilitates movement.
b. Platyhelminthes is an example of the reversion of some protostomes to the acoelomate body plan.
c. The pseudocoelom of some protostomes arose independently in rotifers and roundworms.
d. In Arthropoda and Mollusca, the coelom is drastically reduced, and they have a more complex body plan.
2. The appearance of an exoskeleton, segmentation, and jointed appendages
a. Arthropods
(1) Have an exoskeleton made of chitin and hardened by calcium carbonate (**Fig. 33.7a)**
(2) Move by contracting muscles that pull against the exoskeleton to move jointed appendages
(3) Have a fluid-filled hemocoel that holds internal organs and circulates body fluid
b. Mollusks
(1) Have a muscular foot used for movement, a visceral mass that contains the internal organs and an external gill, and the mantle that covers the visceral mass. (**Fig. 33.7b**)
(2) Are often protected by a calcium carbonate shell that is secreted by the mantle

(3) Move via a hydrostatic skeleton motion generated by the foot.

c. In both arthropods and mollusks, the exoskeleton provides protection from predation.

C. Using the Fossil Record

1. Other than the Bryozoa that appeared after the Cambrian explosion (515 mya), all other protostomes appear very early in animal evolution.
2. Two major events in protostome lineage are illustrated in the fossil record.
   a. The extinction of the trilobites
      (1) Trilobites are extremely abundant in the fossil record from 550 to 440 mya. ()
      (2) Trilobites were arthropods with an exoskeleton, segmented bodies, and jointed limbs.
      (3) They lived on the sea floor and were mostly scavengers or deposit feeders.
      (4) Trilobites disappear from the fossil record at 250 mya.
   b. The appearance of insects
      (1) Insects first appear in the fossil record at 400 mya.
      (2) Winged insects appear in rocks that are up to 370 million years old.
      (3) This period corresponds with the Silurian-Devonian explosion of land plants, implying that the diversification of insects was preceded by that of land plants.

D. Evaluating Molecular Phylogenies

1. Molecular phylogenies using gene sequencing of the rRNA from the small ribosomal subunit demonstrated that protostomes are a monophyletic group that has two distinct lineages, Lophotrochozoans and Ecdysozoans.
2. It is not clear how these two groups diversified or how they are related, but recent results have provided initial data. (**Fig. 32.9**)

III. What Themes Occur in the Diversification of Protostomes?

A. Many different protostome groups moved to land independently—how?

1. They all evolved the ability to exchange gases on land by keeping a moist body surface exposed to air.
2. More important, they all evolved a way to prevent that gas exchange surface, and other body surfaces, from drying out.
   a. Arthropods and mollusks have airtight exoseletons and gas exchange surfaces inside the body.
   b. Insects can close their respiratory passages to keep them from drying out.

B. Protostome feeding strategies are diverse because they have a wide variety of specialized mouth parts.

1. Echiurans (spoon worms) are suspension feeders; they use a proboscis that forms a gutter leading to the mouth. (
2. Nemerteans (ribbon worms) are also suspension feeders; they use a proboscis that can extend and retract.
3. Arthropod mouthparts vary from pinchers to tubes that allow them to feed off a variety of food sources.
4. Many protostomes use their appendages to aid in feeding.
5. Metamorphosis in most protostomes results in larvae and adults that live in different areas and feed on different things, reducing intraspecific (within-species) competition.

C. Protostome variation in movement depends on two things:

1. The presence or absence of limbs
   a. Protostomes that lack limbs move via a hydrostatic skeleton.
      (1) This type of movement is seen in wormlike species.
      (2) It is also observed in larvae (grubs, maggots, caterpillars, etc.).
   b. The evolution of a variety of limbs introduced a variety of movements.
      (1) The evolution of jointed limbs allowed for rapid, precise movement.
      (2) The evolution of the insect wing allowed flight.
      (3) In mollusks, waves of muscle contractions within the foot allow for gliding movements.
      (4) Water intake and forcible ejection through a siphon combine to move the squid via jet propulsion.
2. The type of skeleton present
   a. Hydrostatic skeletons allow movement in those animals without limbs.

b. Exoskeletons provide a point of insertion and resistance for appendage muscles.

D. Reproduction and Life Cycles
1. Asexual reproduction is common in protostomes.
a. Splitting the body lengthwise, or fragmentation, is common in many of the wormlike phyla.
b. Some crustaceans and insects reproduce asexually via parthenogenesis, when an unfertilized egg develops into an offspring.
2. Sexual reproduction is the predominant form of reproduction in most groups.
a. Begins with external fertilization in sessile forms such as clams, bryozoans, and brachiopods
b. Occurs with internal fertilization in crustaceans, snails, and insects
3. Two unique reproductive strategies evolved during protostome diversification.
a. Metamorphosis
(1) Allows juveniles to disperse to new habitats
(2) Reduces competition within species, because juveniles and adults often feed on different things
b. The evolution of an egg that won't dry out on land
(1) Insect eggs have a thick membrane that keeps moisture in.
(2) Snails and slugs have an egg with a thin calcium carbonate shell that retains water.

IV. Key Lineages of Lophotrochozoans

A. What do all lophotrochozoans have in common?
1. Lophophore
a. A special structure that surrounds the mouth of suspension feeders
b. They have tentacles with ciliated cells along their surface.
c. The cilia beat, drawing food (that was trapped by the tentacles) into the mouth.
2. Trochophore
a. A type of larva that has a ring of cilia around its middle.
b. The cilia aid in swimming and help sweep food toward the mouth.

V. Key Lineages of Ecdysozoans

A. What do all ecdysozoa have in common?
1. Ecdysozoans grow by molting—shedding their soft cuticle or hard exoskeletons—then they secrete a new one to fit the bigger body.
2. DNA sequence data shows that this is a monophyletic group with eight phyla.