B.Sc. Biological Science

Annelida

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Annelida is a ubiquitous, common and diverse group of organisms, found in terrestrial, fresh waters and marine environments. Annelida holds an enormous diversity of forms and biological strategies alongside a large number of species, following Arthropoda, Mollusca, Vertebrata and perhaps Platyhelminthes, among the species most rich in phyla within Metazoa. Annelida is a group of highly diverse animals, popularly known as segmented or ringed worms. Annelids are vermiform, bilaterally symmetrical, triploblastic and schizocoelomate animals, whose body is metamerically segmented and covered with a layer of cuticle. The annelids body cells are arranged in three layers, namely epidermis, mesodermis and endodermis. The whole body surface is covered by a thin cuticle, secreted by the epidermis. They exhibit a variety of feeding strategies ranging from deposit feeders, filter feeders, carnivores, herbivores and parasites, thus occupying all levels within the food chain. Blood vascular system is closed type and a respiratory pigment is usually present. Excretion takes place by nephridia. They are mostly aquatic; marine or freshwater some terrestrial, burrowing or tubicolous, sedentary or free-living, some commensally and parasitic. Annelids show a wide variety in the organization of their nervous system proposed a nervous system with paired circume sophageal connectives, four cerebral commissures, five connectives, and numerous commissures in the ventral nerve cord as a hypothetical ground pattern. Annelids show varying grades of brain complexity which may comprise a number of ganglia. Annelids show a variety of reproductive strategies, and sexual as well as asexual reproduction is well-documented for many taxa. Polychaete and oligochaete species can reproduce both sexually and asexually, while leeches can only reproduce sexually. Asexual reproduction does not involve the formation of gametes (eggs and sperm), and it usually occurs either by budding or fission.

For sexual reproduction, different types of free spawning, brooding, and encapsulation of embryos in cocoons can be distinguished, and all types involve either planktotrophic or lecithotrophic developmental stages

Classification of Annelida

Annelida

1. Similiar rings or segments—Metameres or somites; Homonomous metamerism
2. Development of true coelom
3. Nephridia is well developed
4. Capable of complete regeneration
5. Cephalisation firstly appeared
6. Mesoderm is not solid
7. Polychaetae and oligochaetae term given by Grube (1851)
8. Pair appendages are not jointed
9. Only group which uses chaetae aslocomotory organ
10. The phylum Annelida was established by Lamarck (1801)

4 Classes

Polychaeta
1. All marine
2. Somites are many
3. Clitellum is absent

2 Orders

Errantia
1. Numerous and similar somites
2. For example, *Nereis*

Sedentaria
1. Dissimiliar somites and parapodia
2. For example, *Chaetopterus*

Oligochaeta
1. Mostly terrestrial without parapodia
2. Clitellum is present
3. Testes anterior to ovary

3 Orders

Plesiopora
For example,
- *Nais*
- *Tubifex*

Opisthophora
For example, *Pheretima*

Prosopora
For example, *Lumbriculus*

Hirudinea
1. Freshwater and marine
2. Setae, parapodia and tentacles are absent
3. Fixed number of segments (33)

4 Orders

Acanthobdellida
For example, *Achanthobdella*

Rhynchobdellida
For example, *Glossiphonia*

Gnathobdellida
For example, *Hirudo*

Archiannelida
1. Exclusively marine
2. Setae and parapodia are generally absent
3. External segmentation is not well marked
4. Trochophore larva
5. For example, *Polygordius*

Bristles (setae)
Tiny chitin bristles, called setae, help worms cling to and move along surfaces.

Paired Appendages
Pairs of paddle-shaped appendages are used for swimming and gas exchange.

Feeding Tentacles
Tentacles are used for sensing and feeding. The feeding tentacles of the worm shown here make it look like a feather duster.

Suckers
Leeches lack both bristles and appendages. Instead, they have a sucker at each end of the body that they use for locomotion.

Segmentation: The annelid body generally consists of a small pre-segmental region, prostomium, segmented trunk, and small post-segmental region. The prostomium of annelid are contains the brain (cerebral ganglia) as well as the most important sensory structures. The mouth is situated ventrally in the first segment, usually called the peristomium. The each segment of annelids are generally comprises a pair of ganglia in the ventral nerve cord, a pair of coelomic cavities, a pair of metanephridia, and paired ventral and dorsal groups of chaetae. For example leeches show obvious signs of reduced but still recognizable segmentation for instance. The ventral nerve cord clearly allows the number of segments comprising the body to be determined.

Cuticle: The cuticle is composed of an amorphous or filamentous matrix that usually houses layers of parallel collagen fibres which are oriented perpendicularly between the layers. The cuticle is traversed by microvilli extending above the surface and either forms isolated epicuticular projections or multiple tips. This uppermost part is covered by a glycocalix. The cuticle may vary in thickness, number of microvilli, or development of collagen fibres. Especially in larvae and adults of small or interstitial species the collagen fibres appear to be less developed, sometimes more irregularly arranged or even absent. In these cases the cuticle more or less resembles the egg envelope from which it originates

Chaetae and Parapodia: Chaetae are generally regarded as the most characteristic and important taxonomic feature of Annelida. Chaetae are formed by a single cell called a chaetoblast. Chaetae have various functions and may aid in locomotion on the substrate, anchoring the body inside the tubes, protecting and defending the body, supporting parapodia, etc. Annelids are critically important in most marine ecosystems because of their diversity and abundance, especially in soft sediments from the intertidal to the deep-sea, as well as encrusting or attached to hard substrates. They exhibit a variety of feeding strategies ranging from deposit feeders, filter feeders, carnivores, herbivores and parasites, thus occupying all levels within the food chain.

Central nervous system: The central nervous system in Annelida is generally described as a rope-ladder nervous system consisting of a prostomial brain connected with the ventral nerve cord via double circumoesophageal connectives. The ventral nerve cord was generally seen as ropeladder-like chain of paired segmental ganglia connected by connectives and commissures.

Regeration and asexual reproduction in annelids: Annelids are a large and diverse group of invertebrates, with species capable of regenerating a new tail or head or both simultaneously. Certain species can regenerate a whole worm even from a tiny fragment. The most annelids reproduce asexually, mainly by architomy type of transverse fission (a worm splits into fragments which then restore missing heads and tails) or by paratomy (new heads and tails emerge before splitting).

Table 1. Comparison of the main morphogenetic events during the head formation between regeneration and the two types of transverse fission, architomy and paratomy

Event	Anterior part of the body formation during		
	regeneration	architomy	paratomy
Splitting of the body	Occurs prior to regeneration	Occurs after the beginning of architomy	Terminates the process
Wound healing	Starts soon after amputation , lasts for approximately 24 h	Poorly apparent, if any occurs after splitting	Not observed even when paratomy is complete
Cell migration towards the wound site or fission zone	Starts after amputation , before wound epithelium formation	Probably starts prior to splitting	Precedes fission zone formation
Modification of epidermal cells	Limited, occurs during wound healing	Limited, occurs prior to splitting and during wound healing	Apparent, involves almost all epidermal layer of the fission zone, starts at the onset of the process, persists till its termination
Active proliferation of epidermal cells	Starts at the end of wound healing stage and persists through the growth of a regenerate	Starts before splitting and persists through the regeneration of missing structures	Starts at the onset of epidermal cell modification, persists through the process, decreasing by its termination
Blastema formation	Starts next to the onset of active proliferation of epidermal cells; blastema expands noticeably by the beginning of segmentation	Blastema formation precedes splitting, further growth may occur until segmentation starts	Starts after the onset of active epidermal cells proliferation, blastema expands noticeably by the beginning of segmentation

Segmentation and segment positional identity	Oftenly hypomorphic, although the formation of species-specific number of anterior segments is usually accomplished by morphallaxis of old segments adjacent to the wound	Oftenly hypomorphic, old segments undergo morphallactic reorganisation with regard to their new position along the anterior-posterior (AP) axis	The species-specific number of anterior segments is formed by blastema cells; limited morphallaxis of old segments, if present, precedes fission zone formation and persists through the process
Muscular system	Muscles are ruptured; as the blastema grows, terminal ends of longitudinal fibers elongate while circular muscle fibers are formed *de novo*	Muscles undergo some changes to facilitate splitting of a worm into fragments	Muscles undergo some changes to facilitate splitting of new zooids

Event	Anterior part of the body formation during		
	regeneration	architomy	paratomy
Digestive system	Transient reorganisation of the digestive system includes loss of cilia near the wound site and stomach formation (if any) through morphallaxis	Morphallactic digestive system reorganisation along the AP axis	Growth and elongation of the gut at the fission zone with differentiated state persisted; the gut lumen shrinks at fission plane and a new stomach emerges by morphallaxis in the posterior zooid at late stages of fission
Nervous system	Following ventral nerve cord (VNC) rupture, the severed VNC elongates ,new nerve fibers grow out, cerebral commissures and VNC ganglia form	VNC changes, including those at the molecular level precede splitting; after splitting new nerves, cerebral commissures and VNC ganglia develop	VNC changes precede splitting; the changes include transient peripheral nerves formation, new ganglia and cerebral comissures development; VNC is only ruptured when splitting occurs
Changes at the molecular level	Start immediately after amputation	Precede splitting (from several days to 1 week)	Precede morphologically observable fission zone formation and persist through its growth and differentiation