

## CLASS 3. ACTINOPODEA

It is divided into four subclasses:

### Subclass I. Radiolaria

1. A perforated central spherical chitinous capsule separates the protoplasm into inner endoplasm and outer vacuolated ectoplasm.
2. Skeleton of siliceous spicules.
3. Pseudopodia are axopodia.
4. Contractile vacuole absent.
5. Marine.

**Examples.** *Collozoum*, *Thalassicola*, *Lithocircus*.

### Subclass II. Acantharia

1. Strontium sulphate skeleton, usually composed of 20 radial or 10 dimetrical spines.
2. Spines more or less joined in cell centre.
3. Extracellular outer (cortex) and inner envelopes usually present. Inner envelope is called **capsular membrane** closely lining cell mass.
4. Locomotion by axopodia.
5. Marine, mostly planktonic.

**Example.** *Acanthometra*.

### Subclass III. Helizoia

1. Spherical protozoans without central capsule.
2. Skeletal structures, if present, siliceous and organic.
3. Body of most species is naked and differentiated into outer vacuolated ectoplasm and inner dense endoplasm.
4. Axopodia radiate on all sides.
5. There may be more than one nucleus.
6. Most species freshwater, some marine.

**Examples.** *Actinophrys* (uninucleate), *Actinosphaerium* (multinucleate), *Clathrulina* (with perforated test).

### Subclass IV. Proteomyxidia

1. Pseudopodia are filopodia which are slender with pointed tips and are composed of ectoplasm only.
2. Reproduction by binary or multiple fission.
3. Mostly parasite of algae and higher plants.
4. Marine or freshwater.

**Examples.** *Pseudospora*, *Vampyrella*.

## SUBPHYLUM 2. SPOROZOA

The subphylum sporozoa is divided into three classes:

### Class I. Telosporea

1. Spores without polar capsules or filaments.
2. Sporozoites elongated, microgametes flagellated.
3. Trophozoites with one nucleus only.
4. Pseudopodia are absent and mature organism do locomotion by body flexion or gliding.
5. Reproduction is both asexual and sexual.

### Class II. Toxoplasmea

1. Spores are not formed.
2. There are no flagella or pseudopodia at any stage.
3. Only asexual reproduction, i.e., binary fission.
4. Cysts containing many naked sporozoites.
5. They infect birds and mammals causing mental retardation in humans.

Examples. *Toxoplasma*, *Sarcocystis*.

### Class III. Haplosporea

1. Spores are present and have spore cases.
2. Pseudopodia may be present but flagella are absent.
3. Reproduce only asexually by schizogony (i.e., multiple fission of a trophozoite).
4. Parasites of fish and invertebrates.

Examples. *Ichthyosporidium*, *Haplosporidium*, *Caelosporidium*.

### Class I. Telosporea

It is subdivided into two subclasses:

#### Subclass 1. Gregarina

1. Mature trophozoites (gamonts) are large and extracellular living as parasites in the gut and body cavity of invertebrates or lower chordates such as annelids, sipunculids, arthropods, hemichordates or ascidians.
2. Reproduction is entirely sexual with sporogony. Life cycle consisting of gametogony and sporogony.
3. Gametes similar (isogamous).
4. Gametocyte show syzygy (end-to-end union of sporonts).
5. Zygote non-motile forming oocysts within gametocytes.
6. Spores contain eight sporozoites.

Examples. *Gregarina*, *Monocystis*, *Nematocystis*, *Lankestrella*.

#### Subclass 2. Coccidia

1. Mature trophozoites (gamonts) are small and intracellular.
2. Gametocytes are dimorphic.
3. Sporozoites multiply by schizogony in tissue cells.
4. Life cycle characteristically consisting of merogony, gametogony and sporogony.
5. Blood or gut parasites of vertebrates.

Examples. *Eimeria*, *Isospora* and *Plasmodium*.

## SUBPHYLUM 3. CNIDOSPORA

It is divided into two classes:

### Class 1. Myxosporidea

1. Spores of multicellular origin.
2. Spores with two or more valves in their membranes.
3. Trophozoite stage well developed and is the main site of proliferation.
4. They are parasites of cold-blooded vertebrates such as fish.

Examples. *Myxobolus*, *Ceratomyxa*.



### **Class 2. Microsporidea**

1. Spores of unicellular origin.
2. Spores with imperforate wall, having only valve.
3. There is one long tubular polar filament through which the sporoplasm emerges.
4. Mitochondria absent.
5. They are intracellular (cytozoic) parasites in arthropods (e.g., honey bees, silk worms) and vertebrates (e.g., fish).

**Example.** *Nosema*.

## **SUBPHYLUM 4. CILIOPHORA**

The subphylum has the following class:

### **Class Ciliata**

1. Most species are free-living and abundant in both marine and freshwater habitats.
2. Ciliate protozoans have a definite body form and size.
3. Body bounded externally by a firm and elastic pellicle.
4. Locomotory and feeding organelles are cilia.
5. Definite mouth (cytostome) and gullet present. Anal aperture (cytopyge) permanent.
6. Contractile vacuoles are always present at fixed positions.
7. Have two types of nuclei: larger vegetative **macronucleus** and small reproductive **micronucleus**.

8. Binary fission transverse.
9. Sexual reproduction never involves the formation of gametes.

The class Ciliata (or Infusoria) is divided into **four** subclasses:

#### **Subclass 1. Holotrichia**

1. Body cilia uniform (*i.e.*, no distinction between oral cilia and somatic cilia).
2. Cytostome often apical (or subapical) or midventral, on surface of body or at bottom of atrium or vestibulum.

#### **Subclass 2. Peritrichia**

1. Oral ciliary field prominent; body or somatic cilia absent or reduced to temporary posterior circlet of locomotor cilia.
2. Widely distributed species; many are stalked and sedentary (sessile), others are mobile.
3. Dispersal by migratory larval form called **telotroch**.
4. Conjugation total, involving fusion of microconjugants and macroconjugants.

#### **Subclass 3. Suctoria**

1. Sessile (sedentary), stalked adult ciliates with the distal end bearing few to many sucking tentacles (each ending into a sucker-like knob).
2. Adult without cilia; migratory young larva with cilia which originate by budding from posterior end of suctorian.

#### **Subclass 4. Spirotrichia**

1. Large-sized free-swimming ciliates.
2. Body (somatic) cilia reduced.
3. Oral or buccal cilia well marked.
4. Cysts common in some groups.

### Subclass 1. Holotrichia

This subclass is divided into following six orders:

#### Order 1. Gymnostomatida

1. Buccal (or oral) cilia absent, body or somatic ciliation uniform
2. Cytostome opens directly to outside, vestibule (buccal cavity) absent
3. Toxicysts (a type of trichocyst which induce paralysis or lysis of the prey) common

Examples: *Isotritum*, *Cylops*, *Nassula*

#### Order 2. Tytchostomatida

1. Cytostome at the bottom of a ciliated vestibule
2. No buccal cilia, spiral rows of cilia present in the vestibule
3. Endocommensal of vertebrate hosts such as cattle, pig, monkeys and human beings.

Examples: *Balantidium*, *Colpoda*, *Isotricha*.

#### Order 3. Chonotrichida

1. Vase-shaped ciliates lacking in body cilia
2. Sessile (sedentary) forms
3. Vestibular cilia form a spirally coiled apical funnel.
4. Marine and ectocommensal on crustaceans.

Examples: *Spirochona*, *Lobochona*, *Chilodochona*.

#### Order 4. Apostomatida

1. Body with spirally arranged cilia.
2. Cytostome mid-ventral, rosette-shaped in *Foettingeria actinarium*.
3. Marine and parasites or commensals.
4. Life cycle complex, sometimes involving alternation of hosts (unique in phylum), one host is commonly a crustacean.

Examples: *Hyalosphysa*, *Polyspira*, *Foettingeria*.

#### Order 5. Astomatida

1. Body large or long.
2. Mouth absent.
3. Body ciliation uniform.
4. Complex infraciliary endoskeleton and often with elaborate holdfast, organelles (hooks, spines or sucker) at anterior end.
5. Intestinal endoparasites of oligochaetes (terrestrial, freshwater or marine).
6. Asexual reproduction by fission (budding).

Examples: *Anoplophrya*, *Hoplitophrya*.

#### Order 6. Hymenostomatida

1. Body small and with uniform somatic cilia.
2. Buccal cavity well defined; buccal ciliature consists of an undulating membrane and an adoral zone of membranelles.
3. Oral area on ventral surface, usually in anterior half of body.

Examples: *Tetrahymena*, *Paramecium*, *Colpidium*.



## **Subclass 2. Peritrichia**

### **Order Peritrichida**

1. Mostly attached stalked bell-shaped ciliates; the stalk is secreted by a region at the anterior end known as the *scopula*.
2. Feeding apparatus is highly specialised.

**Examples.** *Vorticella*, *Trichodina*.

### **Subclass 3. Suctoria**

1. Body sessile and stalked.
2. Young with cilia, adult with tentacles.

#### **Order Suctorida**

Characters as of subclass suctoria.

**Examples.** *Ephelota*, *Podophrya*, *Acineta*.

### **Subclass 4. Spirotrichia**

It is divided into three orders:

#### **Order 1. Heterotrichida**

1. Generally large to very large forms, often 'highly contractile, sometimes pigmented (e.g. bluish *Stentor*).
2. Body encased in lorica.
3. Body cilia usually absent.
4. Macronucleus oval or often beaded.
5. Parasitic and free-living species.

**Example.** *Stentor*, *Bursaria*, *Blepharisma*, *Nyctotherus*.

#### **Order 2. Oligotrichida**

1. Body ovoid to elongate, sometimes with tail.
2. Pellicle thickened; body (=somatic) cilia reduced.
3. Oral (=buccal) membranelles are limited to front end.
4. Free-swimming, macrophagous, mainly pelagic.

**Example.** *Halteria*.

#### **Order 3. Hypotrichida**

1. Dorsoventrally flattened, highly mobile, with unique cursorial (or running) type of locomotion.
2. Body dominated by compound ciliary structures such as **cirri** which are located on the ventral side of body and used as "legs" for creeping over the substratum.

**Examples.** *Stylonychia*, *Euplotes*, *Oxytricha*.