Protists

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Source:
Encyclopedia of Earth

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Introduction

The taxonomic kingdom Protista is a collection of single-celled organisms that do not fit into any other category. Protists are a group made up of protozoa, unicellular algae, and slime molds. We will concentrate on the animal portion of this group: the protozoa (proto = first, zoa = animals). Protozoa are the oldest known group of heterotrophic life that consume and transform complex food particles into energy. Although protozoans are only made up of a single cell, these organisms manage to perform all the basic tasks of life. The protozoa are divided into four major groups: the ciliates, the flagellates, the heliozoans, and the amoebas.

Morphology (General)

Ciliates:Ciliophora

Structure in this group is fairly diverse, but almost all species retain a few basic characters that help to identify them as ciliates. The first character is the presence of cilia on at least one developmental stage of the organism. Modifications from the full body covered norm include a single ring of cilia, grouped ciliary organelles called cirri, and restriction of cilia to feeding tentacles. Most species also bear toxicysts

that are most likely used to capture and stun prey. These toxicysts can be found around the mouth, along the length of tentacles or anywhere else on the surface of the cell body.

Flagellates:(Zoomastigophora)

Flagellates are characterized by having one or more flagella. Parasitic species generally have more flagella than those that are free living.

Amoebas:Sarcodina

Amoebas can reach a maximum size of 2 mm in diameter. These protozoans are constantly changing shape; they look and move much like balloons half filled with water. When manipulating a water balloon you can force most of the water to one end or hold it so that different sections squeeze out between your fingers. Amoebas change shape like that, only the forces are internal. They can create extensions of their body wall called pseudopodia that help them locomote or capture prey or simply churn up their insides to distribute nutrients. The shape of a pseudopod is generally reflective of the family grouping to which it belongs.

Freshwater radiolarans:Heliozoa

The most identifiable characteristic of the heliozoans is the presence of axopodia. This is a type of pseudopod strengthened by tiny microtubules that extend into solid protective rods. Some marine heliozoans (radiolarians) have a protective exoskeleton of silica, but freshwater species just have tiny silica scales or a perforated capsule.

Morphology (Structures)

All five groups of protozoans include some sessile species but most are swimmers. Ciliates use their many tiny cilia, in controlled waves, to propel themselves through the water. Flagellates have a single posterior flagella that pushes them forward in much the same way as a motor boat uses its propeller. Amoebas locomote by shifting cytoplasm inside their bodies to create pseudopods that slowly pull the organisms along. Finally, heliozoans combine the efforts of cilia and axopods to maneuver their way through the water.

All protozoans have chemical or tactile senses to detect other members of their own species for sexual reproduction, but many of these chemicals have not yet been studied in detail. A sensory structure has been identified in ciliates. Kineties (found beneath the surface of the cell membrane at the base of each cilia), organized in a brushlike formation at the mouth, are used for prey recognition.

Metabolism

Because they are so tiny, protozoans do not need any specialized organelle, such as red blood cells, to meet their oxygen demand. In fact, many can live in water with very low concentrations of oxygen. Some ciliates have specially adapted green algae living inside them. In higher light conditions, these algae convert the carbon dioxide produced by the ciliate into oxygen, ensuring an abundant internal supply of oxygen for the ciliate. On the flip side, a few groups are anaerobic and intolerant of oxygenated water. These organisms are often endosymbionts living in the digestive system of multi-celled animals.

Protists use contractile vacuoles to remove excess water from their cells. If the contractile function of a cell is compromised, the cell swells until it ruptures. The same will also happen to a marine protozoan when placed in fresh water; marine members have no contractile vacuoles. Ciliates have permanent

contractile vacuole pathways and pores where amoebas will release them from any point along the surface of its body.

Reproduction/Development

Many protozoans reproduce both asexually and sexually during their lifetime. The move to sex is often either controlled by an internal clock or by the arrival of harsh environmental conditions.

The majority of protozoans reproduce asexually by binary fission. However, some are endosymbionts (species that live within another organism) that often engage in multiple fission with many tiny cells produced from a single parent cell released to search out a new host.

Sexual reproduction is common in ciliates, but rare in heliozoans and amoebas, and absent in flagellates. The three basic types of sex are gametogamy, autogamy, and conjugation—all of which are explained on the reproduction strategies page.

Ciliates reproduce sexually through conjugation, which involves the exchange of haploid nuclei between two joined protists. Once the genetic information is exchanged, each of the ex-conjugants clones itself. These resulting daughter cells go through a long period of "sexual immaturity," during which they will only reproduce asexually.

Ecology

Flagellates employ their flagella for both swimming and acquiring food. Sessile or colony-forming members of the collared flagellates use their flagella to create a water current to draw small food particles, such as water-borne bacteria. These food particles are then trapped on mucous- coated microvilli (peaks and valleys on the cell membrane that increase the surface area of the cell for the purpose of absorption).

Large amoebas eat algae, other protists and some tiny multi-celled animals, while smaller amoebas feed on bacteria. Amoebas ingest particles by phagocytosis. They wrap themselves around the food particle and once enclosed it is embedded within a food vacuole for digestion. Amoebas can capture food with pseudopods made of any outer area of the cells, so that their whole body surface is a potential mouth! The same is true for pinocytosis (the "drinking" of organic substances) and the release of wastes that are contained in contractile vacuoles.

Ciliates have toxicysts that they fire at their prey to subdue it. Sessile forms (e.g., Suctioria) use haptocysts on feeding tentacles to snag smaller ciliate prey and then suck out the nutritious cytoplasm.

Heliozoans engulf any organism ranging from picoplankton to copepods. Extrusomes at the base of the axopoda secrete cytoplasm over the axopoda. Food sticks to the cytoplasm, and the flow of the liquid brings the food towards the cell where pseudopods reach out to grab it.

Idiosyncratic inverts

Researchers working with the ciliate Paramecium have discovered that protozoans have a very high mortality rate after conjugation. This is attributed to the large number of mutations that accumulate during long bouts of asexual reproduction. Also, the exchange of this information is stressful to the acceptor. Some conjugants will also transmit microscopic prokaryotic endoparasites to the acceptor. These endoparasites allow the new host to clone for a limited amount of time, in order for the prokaryotes to distribute in new hosts. Immediately afterwards, the parasite kills the host.

Citation

Biodiversity Institute of Ontario, Paul D. N. Hebert (Lead Author);Sidney Draggan Ph.D. (Topic Editor) "Protozoa". In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). [First published in the Encyclopedia of Earth August 22, 2008; Last revised Date May 21, 2012; Retrieved September 27, 2012. Encyclopedia of Earth.