The diversity of protoctist cell shape, arrangement and size

Science, Biology

Protoctista are broadly defined as all the unicellular eukaryotes and any multicellular descendants that are neither plants, animals nor fungi (Ridge 2001). The kingdom includes nearly 30 Phyla with thousands of species living in different environments, and adapting in different ways to survive.

The most commonly known and simple protoctist is the Amoeba genus. Amoeba proteus (fig 1) is a single celled amoeba that lacks flagella. It has no cytoskeleton or external test and feeds by phagocytosis. Several pseudopods are formed enabling the organism to move. It has a single nucleus and may be up to 450 ? m in size.

A much smaller group of organisms are the phylum Cryptophyta (fig 2). These unicellular, flat organisms are only 3-5? m in size and are discussed again later.

Protoctista may have no flagella (like Amoeba proteus), one flagella, or be multiflagellates. The Cryptophyta (fig 2) have two flagella with stiff hairs, whilst Giardia lamblia (fig 3), has 8 flagella.

Flagella may be used for movement or feeding. In organisms that use flagella for feeding, the flagella are positioned around specialised areas of the cell (a gullet) and push food towards or into this gullet (fig 2. 7, Ridge 2001)

Although most cells have one nucleus (fig 1), many have more. This can range from two, as in Giardia lamblia (fig 3), to several hundred. Polystomella sp. have one large somatic nucleus for everyday use by the cell and 3 smaller nuclei used only in reproduction (fig 2. 8, Ridge 2001).

Pelomyxa palustris, another non-flagellate, has nearly 2000 nuclei and is one of the largest protoctists; it may exceed 5mm in diameter (Guide to Living Organisms) (fig 2. 2, Ridge 2001).

Polyploidy is seen in some organisms, e. g. Heliospherea inermis (fig 4).

Many organisms strengthen the cell, allowing for increased size by having a cytoskeleton. Actionopods such as Heliospherea inermis (fig 4) further strengthen this cytoskeleton with silica in a lattice formation.

Endoskeletons may be simple strips of protein, as in the euglenoid algae (fig 2. 13a, Ridge 2001) or complex cellulose plates seen in dinoflagellates (fig 2. 13b, Ridge 2001).

Many protoctists form external cell structures (tests or shells). This may be a proteinaceous outer layer as in the Cryptophyta sp (fig 2) or a more complex cellulose and alginate matrix as in Phaeophyta (fig 2. 19, Ridge 2001). Tests are often strengthened with calcium or silica. Polystomella sp. (fig 2. 8, Ridge 2001) is an example of a calcareous test and Asterionella formosa is an example of a test impregnated with silica (Fig 2. 10, Ridge 2001).

The Phaeophyta are a good example of multicellular organisms and differentiation within protoctists. Laminaria hyperborea has a holdfast, stalk, blade and spore producing structures. It has also developed cells (trumpet cells), which specialise in transporting nutrients and waste products around the whole organism (fig 2. 19, Ridge 2001).

Organisms may form colonies, but remain independent cells with little or no differentiation. Asterionella formosa (fig 2. 10, Ridge 2001) forms star shaped colonies whilst Pediastrum biradiatum (fig 5) forms flat circular colonies.

Volvox sp. form spherical colonies consisting of thousands of cells on a ball of mucus and may be up to 1. 5mm in diameter (fig 2. 21b, Ridge 2001). Daughter cells are formed from large a cell, which shows some degree of specialisation.

There is truly a huge amount of diversity within protoctist size, shape and arrangement, from cell size to number of flagella, from number of nuclei to cell support features, from whether the cell is truly individual to whether it is colonial (with or without some degree of cell differentiation) to whether it forms a multicellular organism with a high degree of differentiation.