

CLASSIFICATION OF LIVING ORGANISMS (KINGDOMS)

ANIMALS & PLANTS: When classification schemes were first developed, all living organisms could easily be placed in a general category, like Kingdom Plantae or Kingdom Animalia. General categories, such as Kingdoms still work well in classification but they break down when some organisms in one category have characteristics which are similar to organisms in another category. A case in point is the one-celled organism, *Euglena*, which bears both animal and plant characteristics.

PROTOCTISTA: The establishment of a third Kingdom, proposed around 1860, which contained organisms that did not develop complex tissues somewhat solved this problem. The kingdom which was called Protoctista, or Protista, describes a heterogeneous variety of organisms including algae, fungi, and sponges.

PROKARYOTES: A better but not perfect solution was proposed some 50 years later, when Copeland assigned the name Monera to all single celled organisms with prokaryotic cells (lacking cell organelles) and the remaining organisms with eukaryotic cells were placed in the Kingdom Protoctista. Prokaryotes are bacteria, but beside the heterotrophic species (those that feed on things) there are also autotrophic (self-feeding, i.e. photosynthetic) species, which are sometimes known as blue-green algae or cyanobacteria. Copeland's four kingdom system of classification was considered to be a definite improvement but his system did not recognize the character of nutrition which is a major distinctive element.

FUNGI: In 1969, R. H. Whittaker proposed a five kingdom system which is favoured by many biologists. In Whittaker's system, three kingdoms of more complex organisms are classified according to the three forms of nutrition: photosynthesis [Plants], food ingestion [Animals] and food absorption [Fungi]. The other two kingdoms are distinguished on the basis of differences in cellular structure: no nucleus or other organelles [Prokaryotes], no complex tissues [Protoctista].

ENDOSYMBIOTIC THEORY: Eukaryotes arose when prokaryotes began living inside other prokaryotes – Both mitochondria and chloroplasts have their own DNA, arranged much as in a bacterium.

PROTOCTISTA: Kingdom Protoctista [protos= very first; ktistos= to establish] is defined by exclusion: its members are neither animals (which develop from a blastula), plants (which develop from an embryo), fungi (which lack flagella and develop from spores), nor prokaryotes. Protoctist cells have nuclei and other characteristically eukaryotic properties; most have mitochondria. Nearly all Protoctists are aquatic, some are parasites on other organisms. There is much variation in cell organization, patterns of cell division, and life cycle. It has even been suggested that the major protoctist groups are so distinct from each other as to deserve kingdom status. These divisions are based on their 1) reproductive cells, 2) pigment production and 3) food storage compounds. These groups include Yellow-green algae (Xanthophyta), Dinoflagellates, Diatoms, Euglenoids, Chytrids, Water moulds, and Slime-moulds.

PLANTS: Recent studies on the DNA and biochemistry of algae and plants reveals a remarkable evolutionary history. On the seashore there are three distinct seaweeds distinguished by colour: green, brown and red. It appears that these three lineages separated (in evolutionary terms) over a billion years ago. The colour of these groups relates to the types of photosynthetic pigments, and also to the storage compounds, thus GREEN algae possess Chlorophyll α and β , and store their food products as Starch; BROWN algae possess Chlorophyll α (and small quantities of γ ϵ), and Fucoxanthin, and store their food products as Laminaran; whilst RED algae Chlorophyll α (δ) and Phycobilins, and store their food products as Floridian Starch and Oils. More remarkable still, all mosses, ferns, gymnosperms and angiosperms have evolved from the green algae. They share the same photosynthetic pigments, and the same **ALTERNATION OF GENERATIONS**. Thus in effect there are three plant kingdoms, the GREEN, BROWN and RED Kingdom.

