Classification of Marine Species

Scientists classify living things, or organisms into groups called kingdoms. The five kingdoms are Bacteria, Protocysts, Fungi, Plants, and Animals. Organisms that are related are classified together. Within each kingdom the organisms are divided into groups called phyla (singular phylum). The phyla are further divided into more closely related classes, which in turn contain orders and finally families, genera (singular genus) and species. Every species is allocated a pair of names. The first word in this binomial identifies the genus (always written with an initial capital letter) while the second identifies the individual species (written lower case). Closely related species will share the same generic name.

The names of the genus and species are always printed in italics or if hand written are underlined. For example the classification of the common dolphin is as follows:

**PHYLUM:** Chordata (all animals with backbones)

**CLASS:** Mammalia (all the mammals)

**ORDER:** Cetacea (whales and dolphins)

**FAMILY:** Delphinidae (dolphins and killer whales)

**GENUS:** Delphinus

**SPECIES:** delphis (unique combination of names for the common dolphin)

**Classification can change!**

Since organisms that are related are classified together their classification can change if biologists discover new relationships. For example scientists recently grouped single-celled plants and animals as well as the algae into the Kingdom Protocista. All protocists are micro-organisms and their descendants, that evolved from the combination of two or more different kinds of bacteria. Formerly the single-celled animals were in the Animal Kingdom under the phylum Protozoa and the single-celled plants and algae were placed in the Plant Kingdom. Whatever criteria are used, however, there is a greater difference between the various protocists than between the plants, animals and fungi, and hence the need to recognise the Protocista as a Kingdom in their own right.

As another example of changing classification, the comb jellies were at one time, grouped with the anemones and jelly fishes in the phylum Coelenterata, which are animals with simple sac-like bodies with two cell-layers to the body wall. But the comb jellies are actually very different from the other groups, and nowadays are placed in a separate phylum, the Ctenophora, while all the anemones and jelly fish with distinctive stinging cells belong to the phylum Cnidaria (meaning ‘nettle’).

The Animal Kingdom can be broadly divided into invertebrates (animals without backbones such as crabs and starfish) and vertebrates (animals with backbones such as fishes and whales). Adult seasquirts have no backbones but their tadpole-like larvae have a primitive ‘backbone’ so they are grouped with the vertebrates in the phylum Chordata.

**Comparing land and marine species**

Life began in the sea and many of the phyla of marine organisms were not able to make the transition to life on land. The result is that there are more phyla in the sea than are found on land and in fresh water. There are however, more species on land, the vast majority of which are insects. Groups that are confined to the sea include the Echinodermata (starfish and sea urchins), Ctenophora (comb jellies), Sipunculida (peanut worms), Polychaeta (bristle worms), Bryozoa (moss animals), Brachiopoda (lamp shells), Tunicata (sea squirts) and Pycnogonida (sea spiders). Three large groups that are mainly marine are the Cnidaria (including the anemones, jellyfish and corals), the Crustacea (crabs, barnacles etc.) and the Mollusca (snails, slugs, octopus etc.).
1. KINGDOM BACTERIA

Bacteria are found everywhere. They are the simplest forms of life consisting of cells that lack nuclei and chromosomes (which house the genetic material in other organisms) and have a single layer to the cell wall. Bacteria reproduce by splitting in two. They do this very rapidly and can produce 4,000 million, million, million offspring in just 24 hours. Some can make their own food using the sun’s energy, but most live by decaying plants and animals, or as parasites of living things. ‘Germ’ is a common name for bacteria. They are some of the oldest forms of life, and fossils exist of bacteria that lived 3.5 billion years ago when temperatures were high and there was no oxygen on the earth. Some bacteria can respire anaerobically by breaking down sulphur compounds; others use hydrogen to reduce carbon dioxide. Salt-loving forms regulate the global salinity.

Subkingdom Archaea

Ancient bacteria that evolved under ferociously hot conditions.

- Methane producing bacteria, salt-loving bacteria and sulphur bacteria.

Subkingdom Eubacteria

More recent very diverse group of bacteria.

2. KINGDOM FUNGI

Fungi are the recyclers of the biosphere. They release enzymes and feed by absorbing the digested plant and animal material. They feed saprophytically on dead organic material or are parasites of living plants and animals. There are few fungi in the sea and so the Kingdom Fungi, which includes mushrooms, moulds and yeasts is not dealt with any further here.
Marine examples

The Protoctista are micro-organisms and algae in which the cells have a nucleus with a double layered membrane and at least two different chromosomes which house the genetic material. Cells divide by mitosis. Most use oxygen to respire and contain mitochondria. Many photosynthesise (make their own food using the sun’s energy), but this process always occurs inside plastids. They evolved from symbioses between two different kinds of bacteria, or three or more kinds in the case of algae.

A. SMALL, MAINLY SINGLE-CELLED FORMS COMMON IN PLANKTON

PHYLUM RHIZOPODA: Amoebae
Amoebae are single-celled organisms that move and feed by means of pseudopodia (flowing extensions of the body). May be naked or enclosed in a test. Many form cysts as a resting stage.

PHYLUM GRANULORETICULOSA: Foramenifera
Foramenifera are omnivorous marine organisms related to amoebae and enclosed in a tiny shell riddled with pores. They are a valuable geological tool for mapping the strata of rocks and the sea bed and are used to indicate petroleum deposits.

PHYLUM ACTINOPODA: Radiolarians
Radiolarians are radially symmetrical single-celled organisms with long slender projections of cytoplasm supported by spines. These projections retard sinking, absorb nutrients and trap tiny food items for the animal.

PHYLUM CILIOPHORA: Ciliates
Ciliates are covered with cilia and have two types of nuclei a giant macronucleus and many tiny micronuclei. They engulf their prey in a food vacuole where it is digested.

PHYLUM DINOMASTIGOTA: Dinoflagellates and Zooxanthellae
Dinoflagellates spin through the water driven by two flagella. Most have a shell with a girdle separating the top and bottom halves. Some dinoflagellates are responsible for toxic red tides. Zooxanthellae are photosynthetic, single-celled organisms, living symbiotically with corals, sea anemones and other animals.

PHYLUM BACILLARIOPHYTA: Diatoms
Diatoms are the most abundant aquatic organisms after bacteria. Diatoms are enclosed in a beautifully sculpted shell (test), made up of two valves composed of pectin, impregnated with silica. The two valves are held together by a girdle and may be roughly circular pill-box shaped or boat-shaped. They photosynthesise and have brown pigments (fucoxanthin). The food reserve they produce is the oil chrysolamanarin. Diatoms have a sexual stage in the life cycle.
B. THE SEAWEEDS, MULTICELLULAR FORMS CONFINED TO THE FRINGE OF THE OCEAN

**PHYLUM PHAEOPHYTA: Brown Algae**

Brown algae are largest of the prokaryotes. Nearly all are marine and include the giant kelps, wracks and sargassum. They have single-celled spores that can swim actively using hair-like flagella. Their life cycle consists of a large multicellular, diploid, spore producing generation (the sporophyte) alternating with a small sexually reproducing stage (the gametophyte) with male and female plants. They store carbohydrates in the form of laminarin (not starch) and are brown because they contain a unique brown pigment fucoxanthin in addition to the green pigments chlorophyll a and c that absorb sunlight for photosynthesis.

**PHYLUM RHODOPHYTA: Red Algae**

Red algae are amongst the largest and most complex prokaryotes, with complicated life histories. They have no motile stage although they form sperm that fertilise eggs. Red algae are distinguished by unique red and blue pigments, phycocyanin and phycoerythrin, although they also contain green chlorophyll a. The food reserve is floridean starch, which is different from the starch stored by higher plants. They are a source of the gelling agent agar and are economically important as a food.

**PHYLUM CHLOROPHYTA: Green Algae**

Green algae are algae with grass-green chloroplasts due to the presence of chlorophyll a and b and carotenoids. They produce motile zoospores or gametes during their life-cycles. There are many marine and fresh water species. Green algae are considered to be the ancestors of the land plants which have the same pigments.
The Kingdom Plantae contains multi-cellular organisms that can produce their own food using sunlight, a process known as photosynthesis. Unlike animals, plants cannot move around freely. During their life-cycle they alternate between a haploid, gamete-producing stage (the gametophyte) and a diploid spore-producing generation (the sporophyte). Most of them live on land or in fresh water. Only a few flowering plants such as eel grass and mangrove trees are found in shallow salt water. The Algae were formerly included in the Plant Kingdom but they now belong to the Kingdom Protoctista.

**PHYLUM BRYOPHYA**

These are small plants in which the haploid gametophyte generation is dominant. They occur in moist places or fresh water as they require a surface film of water for reproduction. The sperm swim to reach the flask-shaped archegonia containing the eggs. After fertilisation of the egg, the sporophyte develops on the female gametophyte.

**Class Marchantiopsida:**
Liverworts – Gametophyte a flattened thallus

**Class Antherocerotopsida:**
Hornworts – Gametophyte a flattened thallus, but the sporophytes form a horn-shaped capsule that splits into two valves to release the spores.

**Class Bryopsida:**
Mosses – Gametophytes are leafy upright plants, the sporophyte consists of a capsule on a stalk.

**PHYLUM TRACHEOPHYTE**

These are plants in which the diploid sporophyte generation is dominant. They are differentiated into distinct leaves, stems and roots with strengthening and transporting tissues.

**SUBPHYLUM PTERIDOPHYTE**

The gametophytes are free-living and develop to a moderate size. The sporophyte produces spores that are dispersed by the wind.

**Class Lycopodiopsida:**
Club mosses

**Class Equisetopsida:**
Horsetails

**Class Polypodiopsida:**
Ferns
**Phylum Tracheophyta (continued)**

**Subphylum Coniferophytina (Gymnosperms, the Conifers)**

Large trees, shrubs or plants in which the gametophytes are reduced to cones bearing the pollen and ovules. These large woody trees are abundant in the fossil record.

**Class Pinopsida:**
- Pines, Yellowwoods

**Class Ginkgoopsida:**
- Ginkgo - with distinctive fan shaped leaves

**Class Cycadopsida:**
- Cycads - Palm-like plants bearing large cones

**Class Gnetopsida:**
- Welwitschia - Specialised plants with few large leaves

**Subphylum Magnoliophytina (Angiosperms, the Flowering plants)**

This large diverse group of plants is characterised by bearing flowers and producing seeds. Many are pollinated by insects.

**Class Magnoliopsida:**
- (Dicotyledons): roses, daisies, mangroves etc.

**Class Liliopsida:**
- (Monocotyledons): grasses, sedges, lilies, orchids etc.
The animal kingdom includes multicellular organisms that are able to move around, and survive by eating other animals and plants. There may be 10 million species in the animal kingdom.

Some animals have a circular body plan (radial symmetry) and can move in any direction but are generally not very active (e.g. Cnidaria (jelly fish) and Echinodermata (starfish and sea urchins)). Most other, more active animals, have a definite front and back and have bilateral symmetry. The coiled gastropod snails are asymmetrical.

**PHYLUM PORIFERA: Sponges**
Sponges are simple sedentary animals without a mouth or any organs and consist of a colony of cells loosely held together in a fibrous or glassy skeleton. (About 5 000 species)

**PHYLUM CTENOPHORA: Comb jellies**
Comb jellies are spherical, gelatinous planktonic animals with rows of hair-like cilia.

**PHYLUM CNIDARIA**
Cnidarians are simple, radially symmetrical, sac-like animals with only two cell layers, that possess specialised cells with coiled stings (nematocysts). The mouth is the only opening to the central cavity, which serves as the gut. (About 10 000 species)
PHYLUM PLATYHELMINTHES: Flat worms and parasitic tape worms and flukes
These are flat unsegmented worms. Free living flatworms capture food using a proboscis and the gut is a blind branching tube without an anus. (About 5 500 species)

PHYLUM NEMERTEA: Ribbon worms
These worms are long, thin, ribbon-like creatures that extend a proboscis to collect food. The gut is an open tube ending in an anus. (About 10 000 species)

PHYLUM NEMATODA: Round worms
Round worms are very common, unsegmented cylindrical worms, many of which live among sand and mud or parasitically in the guts of fishes and birds. (About 12 000 species)

PHYLUM SIPUNCULIDA: Peanut worms
Peanut worms are tough unsegmented worms with a short bulbous body and an elongate front end, the introvert, which can be forced out by muscular contraction or rolled back into the body. Tentacles surround the mouth at the tip of the introvert.

PHYLUM ANNELIDA: Segmented worms
Segmented worms include earthworms and leeches but the most numerous marine worms are bristle worms, in which each segment has lateral protuberances bearing tufts of bristles. (About 12 000 species)

PHYLUM ARTHROPODA: Insects, spiders, crabs
Arthropods are animals with jointed limbs and a segmented body that is covered by a hard, jointed, external skeleton. There are few marine insects and spiders. Crustaceans are by far the most numerous and diverse arthropod group in the sea, (about 40 000 species) There are more than 1 million species of insect, mainly on land.
**PHYLUM BRYOZOA: Moss or lace animals**

Bryozoans are colonies of numerous, tiny individuals, each encased in a box-like skeleton. The colonies take on many different forms including flat crusts, upright bushes and lacy corals. These animals are very common but often confused with other plants and animals. (Over 4000 species)

![Moss or lace animals](image)

**PHYLUM BRACHIOPODA: Lamp shells**

Lamp shells outwardly resemble clams but are totally different inside. They have two calcium carbonate plates (valves) to their shells, one ventral below the body and the other dorsally above it. Most are attached by a short stalk. Brachiopods dominated ancient seas but only a few species remain today.

![Lamp shell](image)

**PHYLUM MOLLUSCA: Snails, clams, squid and their kin**

All molluscs have an unsegmented body divided into a head, a foot and a lump of body organs (the visceral mass). Most have a ribbon-like rasping tongue (a radula). Nearly all secrete a calcium carbonate shell that covers the body. (About 40 000 species, over 8 000 species in southern Africa.)

![Molluscs](image)

**PHYLUM ECHINODERMATA: Starfish and sea urchins**

These are animals with five-rayed symmetry, often star- or ball-shaped. All have spines or spicules in their skin. (About 6000 species)

![Echinoderms](image)
**PHYLUM CHORDATA: Rod-backed animals including vertebrates**

Chordates are advanced animals with a dorsal backbone and a nerve cord. The seasquirts are included with the vertebrates because their tadpole larvae have a primitive back rod although it is lost in the adults. (About 44 000 species)

**SUBPHYLUM TUNICATA**

- *Compound ascidians*
- *Red-bait*

**Class Asciidiacea:**
- Sea squirts

**SUBPHYLUM VERTEBRATA: Animals with backbones**

**Superclass Agnatha:**
- Hagfish

**Superclass Pisces:**
- Shark
- Ray
- Fish

**Class Chondrichthyes:**
- Sharks, rays, chimaera, cartilaginous fish

**Class Teleostomi:**
- Bony fish with scales

**Superclass Tetrapoda: Animals with four limbs**

- *Turtle*
- *Seagull*
- *Whale*
- *Seal*

**Class Reptilia:**
- Turtles, snakes

**Class Aves:**
- Birds

**Class Mammalia:**
- Mammals such as whales, seals, otters and humans

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**FURTHER INFORMATION:**