

Kingdoms, Phyla, and More - Tutorial Script

All living organisms are grouped and classified by shared genetic traits into kingdom, phylum, class, order, family, genus, and species. By grouping organisms by shared genetic traits, we better understand physiology and ecological needs as well as the overall evolution of life in the oceans. This video tutorial is a glossary of common marine organism taxonomic classifications. Pause often to digest the information. Apply it regularly to help it sink in.

The BACTERIA KINGDOM includes single-celled prokaryotes with a single chromosome. These bacteria reproduce asexually and exhibit high metabolic diversity. Their roles in the ocean include producing food through photosynthesis or chemosynthesis, converting nitrogen gas into nitrates, which is the necessary form used by most marine autotrophs, and helping to decompose dead organisms. Bacteria can be heterotrophs or autotrophs. An example we discussed in the Life on Earth video tutorial is a type of *cyanobacteria* that created mounds we know as *stromatolites*.

The ARCHAEA KINGDOM is superficially similar to bacteria, but with genes capable of producing different kinds of enzymes. They are also single-celled prokaryotes. They can be heterotrophs and autotrophs. They include most organisms known as extremophiles, as they often live in environments with extreme conditions such as high temperatures near hydrothermal vents or high acidity such as in sulfuric-acid-rich caves in Mexico.

Prokaryotic organisms were the first organisms to evolve on our planet, 3.8 billion years ago, and it's likely chemosynthetic archaea were the very first. Bacteria and Archaea are collectively prokaryotes – and they are distinguished from **eukaryotes**, which evolved after them, by their lack of a nucleus and other more advanced cell components. Eukaryotic organisms evolved about 1 to 2 billion years ago. They have a nucleus and can sexually reproduce.

Pause now. [music]

There are four kingdoms of eukaryotes.

The PROTISTA KINGDOM consists of eukaryotic single-celled, colonial, and multicellular autotrophs and single-celled heterotrophs. They include *diatoms*, *coccolithophores*, *dinoflagellates*, *foraminiferans*, *radiolarians*, and *all kelp and seaweeds*. All single-celled eukaryotic heterotrophs and autotrophs are known as Protista. Multicelled Protista include kelp and seaweeds. You will need to classify these protista further according to the accessory pigments they contain using the following three phyla.

The **CHLOROPHYTA PHYLUM** (or green algae) contain multicellular autotrophs with no pigments other than chlorophyll, though they may contain many different chlorophyll pigment types. These organisms include *sea strings*, *sea lettuce*, and *ocean pin cushion*.

The **PHAEOPHYTA PHYLUM** (or brown algae) contain multicellular autotrophs with chlorophyll AND an accessory brown pigment. These include all *kelp* (*oakblade kelp*, *feather boa kelp*, *giant kelp*, *bullwhip kelp*), *sea palms*, and *rockweed*.

The **RHODOPHYTA PHYLUM** (or red algae) contain multicellular autotrophs with chlorophyll AND an accessory red pigment and include *encrusting and articulated coralline algae*, *brillo pad algae*, *Neptune's washcloth*, *sea sacs*, *iridescent algae*, and *nori*.

The PLANTAE KINGDOM also consists of photosynthetic multicelled autotrophs. However, these evolved from green algae. Plants are primarily terrestrial and have seeds, roots, and leaf-bearing shoots; they conduct all their gas exchange through leaves. Waxy coating on leaves prevents excessive water loss. Hardening of cell walls of woody tissues provide them support on land. The only division found in the marine environment are flowering plants that include *grasses and mangroves*.

If you are a single-celled eukaryotic autotroph or heterotroph, you are part of the Protista Kingdom. However, if you are a multi-celled autotroph, you can be either a Protista or a Plant. What's the difference? Plants are only found where there are soils – they are associated with the land – they have roots, covered seeds, and usually

flower. They have a more rigid body to handle the lack of water support. The only plants in the marine environment are grasses and mangrove trees found along the edges of estuaries. Most autotrophs we discuss in terms of the marine environment will be Protista.

Pause now. [music]

The FUNGI KINGDOM consists of multicelled heterotrophs that live in their food and their own digestive juices. They consist of *mushrooms, molds, and lichen and are all decomposers*. There are no fungi in the marine environment, so we will not discuss them any further in this class.

The ANIMALIA KINGDOM consists of multicellular eukaryotic heterotrophs that don't live in their food as fungi do.

Just to quickly review the five kingdoms, single-celled organisms can be found in the Archaea, Bacteria, and Protista kingdoms. Multicelled can also be found in the Protista kingdom, as well as the Fungi, Plant, and Animal kingdoms. Heterotrophs can be found in all kingdoms except Plants. Autotrophs can be found in all kingdoms except Animals and Fungi.

As you can see from this slide, there are MANY marine phyla found in the oceans. We are choosing a small selection of these to highlight in this video tutorial.

The **PORIFERA PHYLUM** consists of all *sponges*. They are the simplest of all marine animals – sessile, porous filter feeders with no nervous, digestive, respiratory, or circulatory systems. Diffusion of wastes, nutrients, and gases occurs in and out cell walls. (There are separate holes for in and out.) Water is drawn into pores by beating of flagellated cells inside the body. Body walls are supported by spicules (made of glass or calcium carbonate). Sponges can filter 3000x their body volume each day.

Pause now.

The **CNIDARIA PHYLUM** consists of jellyfish and their kin; all are equipped with stinging cells and display radial symmetry. The only opening is a mouth. Cnidaria are shaped like hollow pouches with tentacles lining the hollow opening or digestive cavity. Diffusion moves wastes and gas. They have no excretory or circulatory system. They reproduce by fission of polyps (the sessile form – think of a jellyfish stuck on a rock with its mouth pointing up) or by producing medusa forms (the jellyfish-like planktonic forms), which swim away, produce sperm and eggs, which then combine to create a new polyp. The polyp forms often live in colonies. Cnidaria include *jellyfish, sea anemones, and coral*.

Pause now.

The **BRYOZOA PHYLUM** contains the most widespread and numerous sessile marine animals. They are small, encrusting colonial animals that live inside conjoined calcite square boxes or houses. All bryozoans have LOPHOPHORES, a circular structure spirally wound and lined around its entire perimeter with ciliated tentacles. Bryozoans all have u-shaped digestive tracts, no heads, and are filter feeders. From the outside, bryozoans look a lot like corals, cnidarians that also live in colonies built of CaCO₃ houses, but bryozoans are far more advanced and have no stinging cells. In addition, in coral communities, the polyps themselves are conjoined. In bryozoan colonies, they are not.

Pause now.

The **MOLLUSCA PHYLUM** consists of 58,000 marine species. They are soft bodied, usually protected by a hard CaCO₃ shell. There are three parts to the body: a muscular foot, usually used for movement; a visceral mass containing most of the internal organs; and a mantle: a fold of tissue that drapes over the visceral mass and secretes a shell if one present. Many mollusks have toothed radula used for digging holes in rocks, removing algae from rocks, or drilling through shells. Most also have gills for gas exchange. Mollusks also have obvious heads, flow-through digestion, and a well-developed nervous system. Most have separate sexes with gonads (ovaries or testes). There are four classes of mollusks.

Class **Polyplacophora** consists of mollusks whose shell has eight articulated plates and whose head is reduced. These are also called *chitons*.

Class **Gastropoda** consists of mollusks with an asymmetric body plan, usually with a coiled shell -- one. The foot cannot attach to sand or mud. The radula rasps across rocks, kelp stipes, or surfaces, scraping off food. Gastropods include 43,000 species of *snails*, *limpets*, *abalones*, *sea slugs* and *nudibranchs*, which have no shells.

Class **Bivalvia** consists of mollusks enclosed in twin shells. They have a reduced head and are mostly filter feeders with paired gills. Some use their foot to dig into sand and mud. Their mantle forms siphons that extend to obtain water and eject waste. There are 13,000 species of bivalves including *clams*, *oysters*, *scallops*, and *mussels*.

Class **Cephalopoda** consists of mollusks with a head surrounded by its foot, which is divided into tentacles. Stiff adhesion discs on these tentacles (suction cups) are used to catch prey. The radula is modified into a sharp beak that tears and bites. Shells are reduced, absent, or internal. Locomotion is by jet propulsion using a siphon made from the mantle. There are 450 species of cephalopods including *squid*, *octopus*, *nautiloids*, and *cuttlefish*.

Pause now.

The **ARTHROPODA** PHYLUM consists of animals with a segmented body of two or three parts. There are three or more pairs of legs, jointed appendages (including pincers, mouthparts, walking legs, and swimming appendages), and two pairs of sensory antennae. They are bilaterally symmetrical with an exoskeleton, striated muscles, and a head with a pair of eyes. Arthropoda are the most successful of all animal phyla and include *copepods*, *barnacles*, *krill*, *isopods*, *amphipods*, *shrimp*, *lobsters*, and *crabs*.

Pause now.

The **ANNELIDA** PHYLUM also consists of segmented bilaterally symmetrical organisms. In these worms, however, each segment has its own circulatory, excretory, nervous, muscular, and respiratory systems. Some segments are specialized, such as the head. There are 5400 species on the ocean including most tube worms and the *Feather Duster worm*.

Pause now.

The **ECHINODERMATA** PHYLUM consists of spiny-skinned, benthic, radially symmetrical animals. Most have a water-vascular system: a network of hydraulic canals branching into extensions called tube feet that are used to move, feed, and exchange gases. Internal and external parts radiate from the body center, often as five spokes. A thin skin covers an endoskeleton of hard calcareous plates. Most echinoderm are prickly from skeletal bumps and spines. They lack eyes or a brain. There are 6000 species including *sea stars*, *brittle stars*, *basket stars*, *sea urchins*, *sand dollars*, *sea biscuits*, and *sea cucumbers*.

Pause now.

The **CHORDATA** PHYLUM consists of 45,000 species of animals that share in common a few structures that appear at some point during their lifetime: a notochord, a dorsal, hollow nerve chord; gill slits; and a muscular, postanal tail. This phylum consists of two subphylum:

Subphylum **Urochordata** consists of mostly sessile filter feeders. Some are colonial. Each organism is covered by a tunic with two openings: one for water in and the other for water out. Urochordata possess a notochord only in their larval forms. They include *sea squirts*, *tunicates*, and *salps*.

Pause now.

Subphylum **Vertebrata** consists of chordata that retain their notochords.

Subphylum Vertebrata include the following classes:

Class **Agnatha** or Jawless Fish consists of 50 species of fish with no jaws, a cartilaginous skeleton, and a rasping tongue. They have no paired appendages and include *lampreys* and *hagfish*.

Class **Chondrichthyes** (or **cartilaginous fishes**) consists of fish with a cartilaginous skeleton and jaws. Gas exchange happens through gills. They use internal fertilization and produce either eggs or give live birth. They have acute senses including lateral lines that pick up electrical signals and movements in the water. They have paired fins, no swim bladder, and gill slits. They consist of *sharks, skates, rays, sawfish, and chimera*.

Class **Osteichthyes** (or **bony fish**) consists of fish with hard, strong, light-weight bony skeletons, paired fins, and jaws. An operculum covers their gills. Most have external fertilization and lay large numbers of eggs. Gas exchange happens through gills. Many have swim bladders. Bony fish include *salmon, tuna, sea bass, anchovies, eels, sea dragons and sea horses, and many more*.

Pause now.

Class **Reptilia** consists of four-limbed chordates with scaly skin; Gas exchange happens via lungs; they lay amniotic shelled eggs or give live birth. They are cold blooded. Special salt glands concentrate and excrete excess salts from body fluids. Except for one turtle species, they require warm waters. They include *sea snakes, crocodiles, and sea turtles*.

Class **Aves** or birds consists of four-limbed chordates with feathers. Forelimbs are modified as wings. Gas exchange also happens through lungs. They have internal fertilization, breed on land and lay eggs on land. They also produce shelled amniotic eggs. They have acute vision and are warm blooded. They include *penguins, gulls, pelicans, albatross, petrels, puffins and many more*.

Pause now.

Class **Mammalia** consists of warm-blooded four-limbed chordates whose young are nourished from mammary glands of their mothers. They have hair, a diaphragm that ventilates their lungs, and mostly give live birth that develops within an amniotic sac. There are 4300 marine species and they all evolved from land mammals, having returning to the sea 30-40 million years ago. Mammals consist of these orders:

Order **Cetacea or whales** consists of 79 species. They all have fish-shaped bodies, paddle-like forelimbs, no hind limbs, and a thick layer of insulating blubber. They consist of two suborders:

Suborder Odontoceti or **Toothed whales** are predators that have teeth. They consist of *pilot whales, beluga whales, killer whales, dolphins, porpoises, sperm whales, and narwhales*.

Suborder Mysticeti or **Baleen whales** have no teeth. Instead they have plates of baleen that hang from their upper jaw and that they use to filter food out of the water. Most have a dorsal fin and a grooved, distensible throat. They consist of *gray whales, humpback, fin, sei, blue, Bryde's, minke, black right, and bowhead whales*.

Order **Sirenia** or Sea Cows consists of grass-eating mammals that live in mangrove swamps and possess finlike forelimbs with no hind limbs. They consist of *manatees and dugongs*.

Order **Carnivora** consists of carnivorous mammals that possess sharp, pointed canine teeth and molars for shearing and clawed toes. They consist of two suborders:

Suborder **Pinnipedia** consists of flipper-footed carnivora that can safely come out on land to rest, breed, and give birth. They have a thick, insulating blubber and include seals, sea lions, and walruses.

Suborder **Fissipedia** consists of toe-footed carnivora with no blubber – warmth comes from thick fur. They include sea otters and polar bears.

Pause now.

[end credits]

Classifying Marine Organisms Video Series:

Part 1: Nekton, Benthos, and Plankton

Part 2: Feeding Methods

Part 3: Kingdoms, Phyla, and More

Kingdoms, Phyla, and More

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