MARINE INVERTEBRATES

LINNE
pLatform for INnovation in Natural science onlinE education

Co-funded by the European Union

ACQUARIO DI GENOVA
VIVA, LA NATURA!

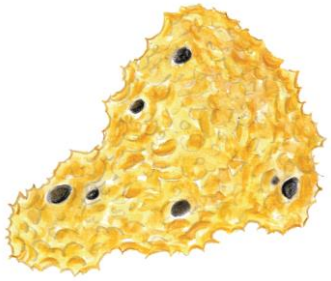
MARINE INVERTEBRATES

Invertebrates are all animals that **lack a backbone**.

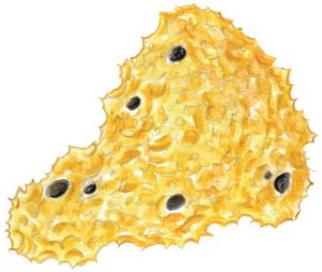
Many of them use a rigid external structure to protect their soft bodies or allow them to move.

To help us get to know this huge group of animals, zoologists, the scientists who study animals, have created groups that include invertebrates with similar characteristics.

Let us discover the **most common groups** of marine invertebrates.



PORIFERA



Porifera are better known as **sponges**.

They are **very simple invertebrates**, with no real tissues, that live mainly in the sea, attached to poorly lit rocky bottoms. Some species live in freshwater.

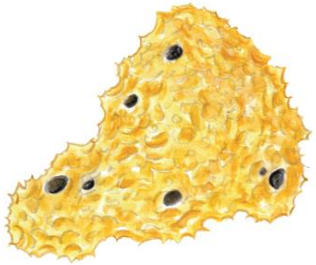
Their bodies can have very bright colours and **different shapes**: small barrel-shaped, tree-shaped, ball-shaped.

Some species form thin layers on rocks and are therefore called encrusting sponges.

Sponges have a supporting structure, the nature of which varies according to the group to which they belong.

Tree-shaped sponge

Encrusting sponge



One particular group of sponges has a network of soft, elastic fibres that remain intact even after the animal has died: these are the sponges that have been fished for centuries and used as bath sponges.

If you look closely at the surface of a sponge, you will see many **tiny holes** or **pores** (poriferous means 'pore-bearing').

Water, which is rich in nutrients and oxygen, enters through the pores and is pushed into the sponge by special cells with very fine hairs.

Other cells are responsible for digesting food, transporting nutrients throughout the body and eliminating waste.

The water is then expelled through a **larger opening** at the top of the animal's body.

Ph. Meruyert Gonullu

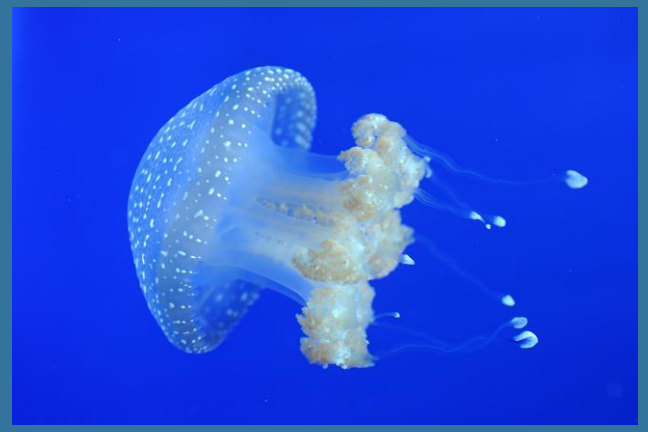
CNIDARIANS

Cnidarians include rather well-known animals, such as **jellyfish, corals** and **sea anemones**.
They come in two forms: the **jellyfish** form and the **polyp** form.

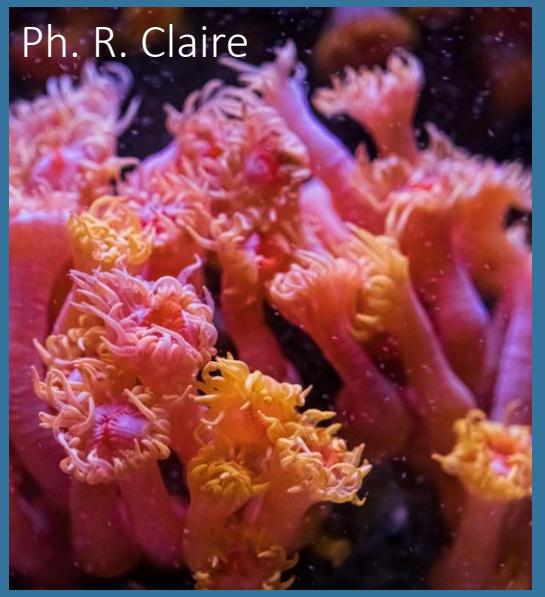
The jellyfish form is known to everyone, the polyp form perhaps less so.

The polyp resembles a flower in appearance, where what look like petals are actually tentacles.

Unlike the jellyfish which, with a few rare exceptions leads a planktonic life, the **polyp** spends its entire life **attached to the bottom.**



Jellyfish form



Polyp form

Both forms have common characteristics, however:

- The presence of a **single opening** that serves both **to feed and to expel waste** substances from the body.
- The presence of **tentacles around the mouth**.
- The presence of special **stinging organelles**, mainly concentrated along the tentacles, which, on contact with an organism, inject a paralysing toxin, which differs from species to species.

Jellyfish

The **body** of jellyfish, which is **gelatinous** in consistency and made up almost entirely of water, resembles a dome in appearance and is called a **bell**.

Barrel jellyfish

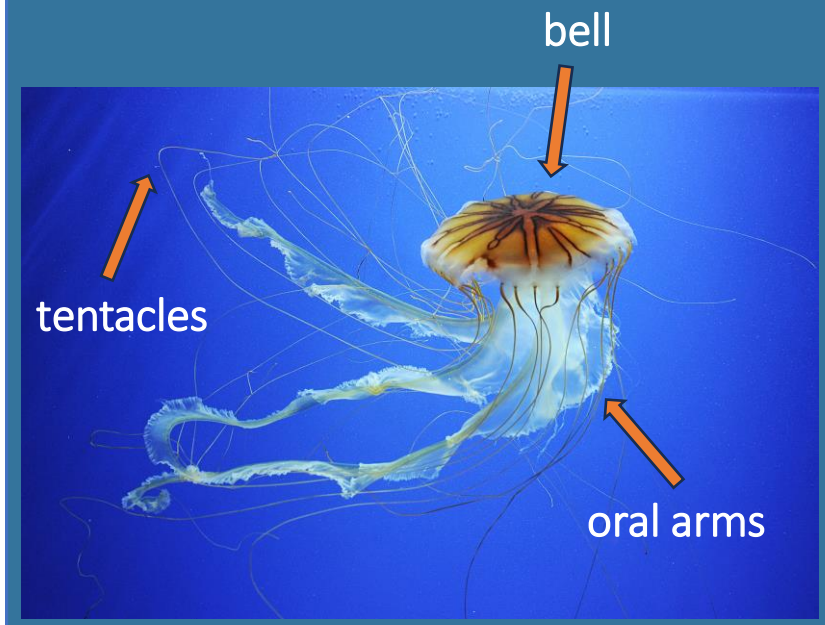
On the lower surface of the bell is the **mouth**, surrounded by **oral arms** used to carry food to the mouth. **Urticating organelles** are mainly found along the oral arms and the **tentacles**, which are distributed along the edge of the umbrella.

After having touched and immobilised their prey, the jellyfish carry it to their mouth with their tentacles.

They **feed** mainly **on small planktonic animals**.

Jellyfish have very complex **sense organs** that enable them to perceive the intensity of light and the orientation of their bodies, so that they do not end up... with their tentacles in the air!

These organs, called **rhopalia**, are found along the edge of the bell in varying numbers in different species.



Madrepores, gorgonians and sea anemones.

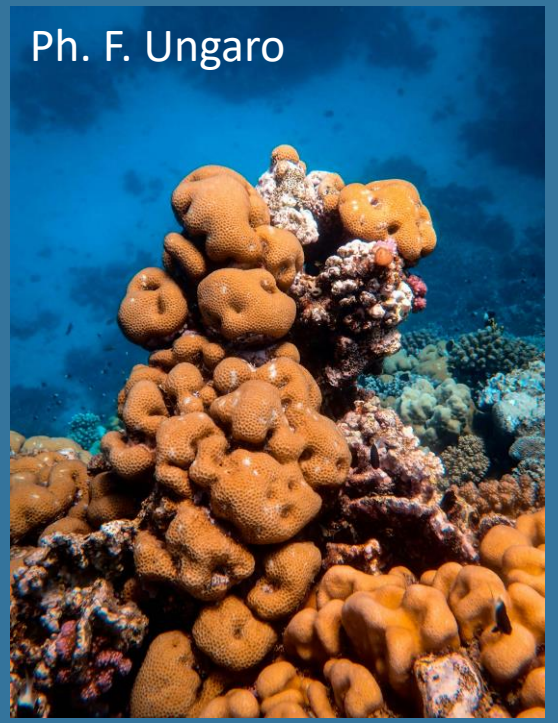
These Cnidarians are all polyp-shaped.

Madrepores

Madrepores, or **hard corals**, are the main contributors to tropical coral reefs, one of the richest ecosystems for life on the Planet, comparable in species diversity to rainforests.

Hard corals are **mostly colonial animals**, composed of hundreds of thousands of tiny polyps, connected to each other by a thin layer of tissue. Each polyp has a **mouth**, surrounded by a **crown of stinging tentacles**, which is used to catch **prey**, consisting mainly of **zooplankton**.

Each polyp produces a kind of **rigid cup** inside which it protects its mushy body. This structure is made of calcium carbonate, a salt that the small animal obtains from sea water. Most coral polyps do not exceed 5 mm in length.

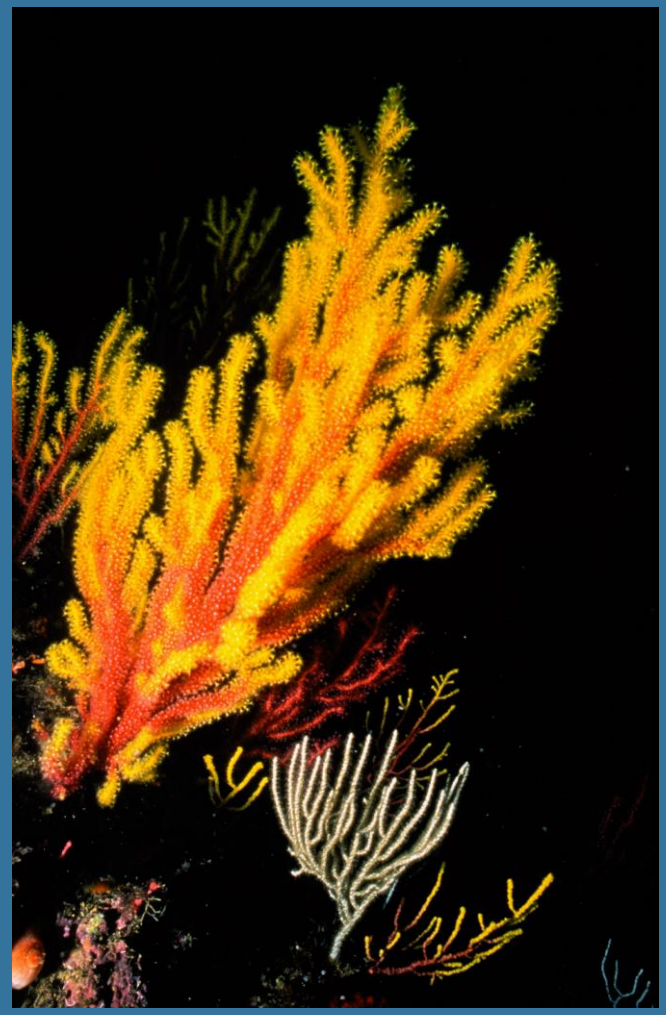


Hard corals

Madrepores host microscopic **unicellular algae in their tissues**: the zooxanthellae. These, through chlorophyll photosynthesis, produce part of the nutrition for the entire colony!
The corals reciprocate by providing the algae with a safe shelter and the substances they need to carry out photosynthesis. It is precisely the zooxanthellae that are responsible for the brilliant colouration of the corals.

Gorgonians

Gorgonians are also colonial Cnidarians. They are often called *sea fans* because **their branches** often **form a** large, **flat network** which, as they develop perpendicular to sea currents, allows them to intercept a large amount of plankton, on which they feed.



Gorgonians

Their support structure is more flexible than that of madrepores. They can have very bright colours depending on the species.

Sea anemones

Sea anemones consist of a single polyp.
The body is cylindrical in shape and adheres to the seabed, on which it can slowly crawl.
The upward-facing mouth is surrounded by numerous tentacles, with which it catches plankton and small fish.

The **beadlet anemone** inhabits the rocks in the tidal zone; at low tide it withdraws its tentacles, taking on the appearance of a small gelatinous ball.

Beadlet anemone

MOLLUSCS

Most Molluscs protect their soft bodies by producing a rigid structure: **the shell**.
Scientists classify different Molluscs according to the shape of their shell.
Let's discover the three most important groups of Molluscs.

Bivalves

The **shell** of Bivalves, such as mussels, clams or oysters, consists of **two parts**, called **valves**, joined by a strong ligament.
The valves can open and close, in case of danger, thanks to powerful muscles.
They are filter-feeding animals: food particles carried by the water are retained by the gills.
They lead sedentary lives: they live anchored to rocks or buried in sand or mud on the seabed.

Mussels

Gastropods

They have a **conical spiral shell** that may be more or less developed or, in some cases, even absent.
They move by crawling slowly along the seabed with a body part called a foot.
To this group belong the (terrestrial) snail, the rock snail and the triton snail.
Nudibranchs are a group of small Gastropods without a shell, characterised by a very lively colouration.
Some species of Gastropods, whose shell has shrunk or disappeared, lead planktonic lives.

Cephalopods

They have a very reduced inner shell, as in the squid and cuttlefish, or none at all, as in the octopus.

Triton snail

The nautilus is the only Cephalopod that retains a large outer shell, a flat spiral, divided into chambers, the outermost of which is occupied by the mollusc.

The body of a Cephalopod consists of a voluminous **head** from which develop 8 or 10 **arms**, depending on the species, **rich in suckers.**

At the centre of the arms is the mouth, consisting of a kind of very powerful horny beak.

They have a highly developed brain and possess the **most complex eyes among invertebrates**.

Cephalopods are found in all marine environments, from tropical to polar waters.

Some species lead benthic lives, while others live in the open sea.

They vary in size depending on the species, ranging from the few millimetres in length of some musky octopuses, to 20 m. and more of giant squids.

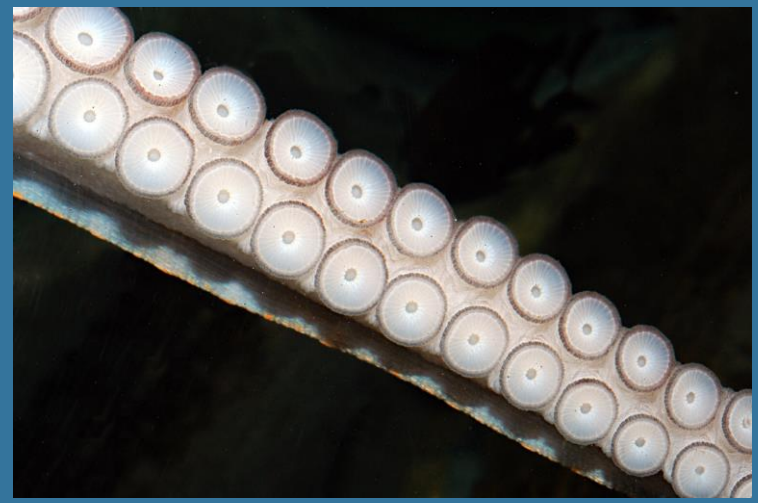
Cuttlefish

Octopus

One of the characteristics of Cephalopods is their **ability to take on the colours and sometimes the shapes of their environment**.

This allows them to approach prey undisturbed and escape predators. The change of colour is often also a manifestation of their mood. Cephalopods are **all carnivores**; their arms, equipped with suckers, are highly efficient weapons and are used by all species to hunt, but strategies vary depending on the living environment and the prey to be caught.

The octopus is known for its **intelligence**. Several experiments have shown how these invertebrates are able to remember locations and positions of objects, but also to learn how to open jars or use tools to reach food.



Suckers

CRUSTACEANS

Crustaceans are part of the **Arthropod** group, **the largest of the animal kingdom**, the same group to which Insects belong.

The feature common to all Crustaceans is an external rigid skeleton, or **exoskeleton**, covering their body and their appendages.
The exoskeleton, which resembles the armour of a medieval knight, is composed of a substance called chitin and provides the animal with protection and support.

This '**armour' must be periodically replaced** with a larger one as the Crustacean grows.
This phenomenon is called moulting and occurs several times during the life of a Crustacean.

Spiny lobster

The new coating begins to form under the old one, before the latter is abandoned. Initially soft, it gradually hardens on contact with the salts contained in the seawater when the moult is complete. During this phase, which is generally rather short, the animal, deprived of its 'armour', is very vulnerable and therefore takes shelter in safe nooks and crannies.

The **smaller forms** of Crustaceans **take in oxygen** directly **from the surface of the body**, while **the larger**, more complex **ones breathe through gills**.
Their external **appearance varies greatly among the different groups**, but they all possess two pairs of antennae, with a sensory function, and numerous slender legs, specialised to perform a variety of functions: moving along the bottom, swimming, adhering to the bodies of other animals, reproducing or feeding.

Paromola

Most Crustaceans are equipped with **compound eyes**, i.e. made up of thousands of small units, organised in a mosaic pattern.
The eye of the lobster consists of as many as 14,000 units!

Scientists have shown that the **most evolved** Crustaceans **are able to distinguish colours**: some hermit crabs, for example, can distinguish yellow and blue painted shells from grey ones.

Crustaceans live in the most diverse environments: on the seabed, in open waters at the mercy of currents, in reef pools and even on other animals.
Let's meet the most common Crustacean groups!

Mediterranean shrimp

Planktonic Crustaceans

Copepods dominate everywhere in the oceans, making up at least 70% of **zooplankton**.
These tiny Crustaceans use their appendages to generate water currents that direct the small organisms they feed on close to their mouths.

Important planktonic Crustaceans are also the **Euphausiacea**, similar to shrimps and known by the term 'krill'. Present in all the world's oceans, they are particularly abundant in cold and polar waters.
Krill is a favourite **prey of whales**.

Krill

"Fixed" Crustaceans

Barnacles are Crustaceans so strange that they were once confused with Molluscs. Some of them are very common on wave-washed rocks, on which they live fixed.

Barnacles

The body of these Crustaceans is enclosed within a 'shell', formed of rigid calcareous plates that, when necessary, open to reveal feathery appendages that they use to filter water.

The most famous Crustaceans

Prawns, lobsters, and crabs belong to the **Malacostracans**, perhaps the most famous group of Crustaceans, not least because of their considerable commercial value.
They have **five pairs of appendages**, the first of which **may have claws** and be **used for predation or defence**.

Shrimps and prawns have different lifestyles in different species: some swim in the open sea and can live even at great depths; others live on the bottom, hidden under stones and shells or in the crevices of rocks.

Shamefaced crab

Lobsters also live on the seabed and have a nocturnal life, while during the day they stay hidden among the cracks in the rocks.

The **hermit crab** is a very peculiar Crustacean: its **exoskeleton is not complete** but only covers the front part and the first three pairs of legs.
To protect the remaining part of its body, which is soft and curved, it slips into the empty shell of a Gastropod it finds on the seabed, from which it emerges with its head.
As it grows, the hermit crab not only changes its exoskeleton, but also its shell.
The search for a new 'home' is very laborious and the invertebrate wanders around on the seabed lifting the shells it finds to assess their weight, which is crucial for making the right choice.

Hermit crab

ECHINODERMS

Echinoderms have a kind of armour under their skin, consisting of rigid plates that are more or less fused together, depending on the different groups.
To this group belong apparently very different animals; the best known are starfish, sea urchins and holothurians.

Sea urchins

They are well known and feared for the **spines** that protect their bodies.
The spines are **mobile and vary in length depending on the species**: they are connected to the skeleton, which consists of strong plates welded together to form a single structure.
Not all urchins have spherical bodies and sharp spines: some forms, such as sand dollars, have a flattened body and very short spines.

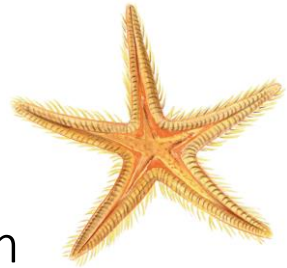
Sea urchin

The sea urchin's mouth, known as *Aristotle's lantern*, is in contact with the seabed.
It consists of a set of muscles and 40 calcareous pieces, of which five are arranged in a circle and function as powerful teeth.
The urchins are able, with this chewing apparatus, to scrape and even shatter the seabed on which they are resting until they dig themselves a shelter.
Most urchins **feed mainly on algae**.

Usually, sea urchins remain hidden during the day, but at night they come out to find food.
Some species habitually **cover themselves with objects** they find on the bottom to camouflage themselves.

Sea urchin dermaskeleton

Starfishes



Starfishes have a **flat body**, formed by a **central disc**, from which **arms**, the number of which can vary from five to around fifty, depart.

Along the lower surface of each arm is a system of tiny **suckers** (*ambulacral pedicels*) that enable these animals to move and grasp prey.

Starfish **can reform missing body parts**; some species are able to reconstruct their entire body from a single arm, provided this also includes part of the central disc.

They are very fond of molluscs, crustaceans, other echinoderms, and the rests of dead animals.

Species that feed on mussels and the like use a **very special technique** to enjoy their meal: they lie down on their prey and, after slightly opening the two parts of the shell, insert their stomach, which can be everted from the body, into it and begin to digest it. Once the meal is over, the stomach returns to its place.

Ambulacral pedicels

Holoturians

Holoturians are also known as **sea cucumbers** because of their shape.

They have a **soft, cylindrical body** at the end of which is the mouth, surrounded by a crown of tentacles used to collect food.

Their **skeleton is invisible**, consisting of microscopic plates scattered around the outside of the body.

Rows of tiny **ambulacral pedicels** run the **length of the body**, allowing the animal to move along the seabed in search of the detritus and organic particles on which it feeds.

Sea cucumber

LINNEO

pLatform for INnovation in Natural science onlinE education

Co-funded by the European Union

LINNEO project has been funded with the support of the European Commission.
The responsibility for the content of this publication is borne solely by the publisher;
the Commission is not liable for any further use of the information contained therein.