

= Mollusca =

The molluscs or mollusks / ˈmʌlɪsks / compose the large phylum of invertebrate animals known as the Mollusca . Around 85 000 extant species of molluscs are recognized . Molluscs are the largest marine phylum , comprising about 23 % of all the named marine organisms . Numerous molluscs also live in freshwater and terrestrial habitats . They are highly diverse , not just in size and in anatomical structure , but also in behaviour and in habitat . The phylum is typically divided into 9 or 10 taxonomic classes , of which two are entirely extinct . Cephalopod molluscs , such as squid , cuttlefish and octopus , are among the most neurologically advanced of all invertebrates ? and either the giant squid or the colossal squid is the largest known invertebrate species . The gastropods ( snails and slugs ) are by far the most numerous molluscs in terms of classified species , and account for 80 % of the total . The scientific study of molluscs is called malacology .

The three most universal features defining modern molluscs are a mantle with a significant cavity used for breathing and excretion , the presence of a radula ( except for bivalves ) , and the structure of the nervous system . Other than these things , molluscs express great morphological diversity , so many textbooks base their descriptions on a " hypothetical ancestral mollusc " ( see image below ) . This has a single , " limpet @-@ like " shell on top , which is made of proteins and chitin reinforced with calcium carbonate , and is secreted by a mantle covering the whole upper surface . The underside of the animal consists of a single muscular " foot " . Although molluscs are coelomates , the coelom tends to be small . The main body cavity is a hemocoel through which blood circulates ; their circulatory systems are mainly open . The " generalized " mollusc 's feeding system consists of a rasping " tongue " , the radula , and a complex digestive system in which exuded mucus and microscopic , muscle @-@ powered " hairs " called cilia play various important roles . The generalized mollusc has two paired nerve cords , or three in bivalves . The brain , in species that have one , encircles the esophagus . Most molluscs have eyes , and all have sensors to detect chemicals , vibrations , and touch . The simplest type of molluscan reproductive system relies on external fertilization , but more complex variations occur . All produce eggs , from which may emerge trochophore larvae , more complex veliger larvae , or miniature adults .

Good evidence exists for the appearance of gastropods , cephalopods and bivalves in the Cambrian period 541 to 485 @. @ 4 million years ago . However , the evolutionary history both of molluscs ' emergence from the ancestral Lophotrochozoa and of their diversification into the well @-@ known living and fossil forms are still subjects of vigorous debate among scientists .

Molluscs have been and still are an important food source for anatomically modern humans , but with a risk of food poisoning from toxins that accumulate in molluscs under certain conditions , and many countries have regulations to reduce this risk . Molluscs have , for centuries , also been the source of important luxury goods , notably pearls , mother of pearl , Tyrian purple dye , and sea silk . Their shells have also been used as money in some preindustrial societies . Mollusc species can also represent hazards or pests for human activities . The bite of the blue @-@ ringed octopus is often fatal , and that of *Octopus apollyon* causes inflammation that can last for over a month . Stings from a few species of large tropical cone shells can also kill , but their sophisticated , though easily produced , venoms have become important tools in neurological research . Schistosomiasis ( also known as bilharzia , bilharziosis or snail fever ) is transmitted to humans via water snail hosts , and affects about 200 million people . Snails and slugs can also be serious agricultural pests , and accidental or deliberate introduction of some snail species into new environments has seriously damaged some ecosystems .

= = Etymology = =

The words mollusc and mollusk are both derived from the French mollusque , which originated from the Latin molluscus , from mollis , soft . Molluscus was itself an adaptation of Aristotle 's ?? ????? ta malaká , " the soft things " , which he applied to cuttlefish .

The name Molluscoida was formerly used to denote a division of the animal kingdom containing the brachiopods , bryozoans , and tunicates , the members of the three groups having been supposed

to somewhat resemble the molluscs . As it is now known these groups have no relation to molluscs , and very little to one another , the name Molluscoida has been abandoned .

= = Definition = =

The most universal features of the body structure of molluscs are a mantle with a significant cavity used for breathing and excretion , and the organization of the nervous system . The most abundant metallic element in molluscs is calcium .

Molluscs have developed such a varied range of body structures , it is difficult to find synapomorphies ( defining characteristics ) to apply to all modern groups . The most general characteristic of molluscs is they are unsegmented and bilaterally symmetrical . The following are present in all modern molluscs :

The dorsal part of the body wall is a mantle ( or pallium ) which secretes calcareous spicules , plates or shells . It overlaps the body with enough spare room to form a mantle cavity .

The anus and genitals open into the mantle cavity .

There are two pairs of main nerve cords .

Other characteristics that commonly appear in textbooks have significant exceptions :

= = Diversity = =

Estimates of accepted described living species of molluscs vary from 50 @, @ 000 to a maximum of 120 @, @ 000 species . In 1969 David Nicol estimated the probable total number of living molluscs at 107 @, @ 000 of which were about 12 @, @ 000 fresh @-@ water gastropods and 35 @, @ 000 terrestrial . The Bivalvia would comprise about 14 % of the total and the other five classes less than 2 % of the living molluscs . In 2009 , Chapman estimated the number of described living species at 85 @, @ 000 . Haszprunar in 2001 estimated about 93 @, @ 000 named species , which include 23 % of all named marine organisms . Molluscs are second only to arthropods in numbers of living animal species ? far behind the arthropods ' 1 @, @ 113 @, @ 000 but well ahead of chordates ' 52 @, @ 000 . About 200 @, @ 000 living species in total are estimated , and 70 @, @ 000 fossil species , although the total number of mollusc species ever to have existed , whether or not preserved , must be many times greater than the number alive today .

Molluscs have more varied forms than any other animal phylum . They include snails , slugs and other gastropods ; clams and other bivalves ; squids and other cephalopods ; and other lesser @-@ known but similarly distinctive subgroups . The majority of species still live in the oceans , from the seashores to the abyssal zone , but some form a significant part of the freshwater fauna and the terrestrial ecosystems . Molluscs are extremely diverse in tropical and temperate regions , but can be found at all latitudes . About 80 % of all known mollusc species are gastropods . Cephalopoda such as squid , cuttlefish , and octopuses are among the neurologically most advanced of all invertebrates . The giant squid , which until recently had not been observed alive in its adult form , is one of the largest invertebrates , but a recently caught specimen of the colossal squid , 10 m ( 33 ft ) long and weighing 500 kg ( 1 @, @ 100 lb ) , may have overtaken it .

Freshwater and terrestrial molluscs appear exceptionally vulnerable to extinction . Estimates of the numbers of nonmarine molluscs vary widely , partly because many regions have not been thoroughly surveyed . There is also a shortage of specialists who can identify all the animals in any one area to species . However , in 2004 the IUCN Red List of Threatened Species included nearly 2 @, @ 000 endangered nonmarine molluscs . For comparison , the great majority of mollusc species are marine , but only 41 of these appeared on the 2004 Red List . About 42 % of recorded extinctions since the year 1500 are of molluscs , consisting almost entirely of nonmarine species .

= = A " generalized mollusc " = =

Because of the great range of anatomical diversity among molluscs , many textbooks start the subject of molluscan anatomy by describing what is called an archi @-@ mollusc , hypothetical

generalized mollusc , or hypothetical ancestral mollusc ( HAM ) to illustrate the most common features found within the phylum . These species reproduce through binary fission , much like a sea star . The depiction is rather similar to modern monoplacophorans , and some suggest it may resemble very early molluscs .

The generalized mollusc is bilaterally symmetrical and has a single , " limpet @-@ like " shell on top . The shell is secreted by a mantle covering the upper surface . The underside consists of a single muscular " foot " . The visceral mass , or visceropallium , is the soft , nonmuscular metabolic region of the mollusc . It contains the body organs .

= = = Mantle and mantle cavity = = =

The mantle cavity , a fold in the mantle , encloses a significant amount of space . It is lined with epidermis , and is exposed , according to habitat , to sea , fresh water or air . The cavity was at the rear in the earliest molluscs , but its position now varies from group to group . The anus , a pair of osphradia ( chemical sensors ) in the incoming " lane " , the hindmost pair of gills and the exit openings of the nephridia ( " kidneys " ) and gonads ( reproductive organs ) are in the mantle cavity . The whole soft body of bivalves lies within an enlarged mantle cavity .

= = = Shell = = =

The mantle edge secretes a shell ( secondarily absent in a number of taxonomic groups , such as the nudibranchs ) that consists of mainly chitin and conchiolin ( a protein hardened with calcium carbonate ) , except the outermost layer in almost all cases is all conchiolin ( see periostracum ) . Molluscs never use phosphate to construct their hard parts , with the questionable exception of *Cobcrephora* . While most mollusc shells are composed mainly of aragonite , those gastropods that lay eggs with a hard shell use calcite ( sometimes with traces of aragonite ) to construct the eggshells .

The shell consists of three layers : the outer layer ( the periostracum ) made of organic matter , a middle layer made of columnar calcite , and an inner layer consisting of laminated calcite , often nacreous .

= = = Foot = = =

The underside consists of a muscular foot , which has adapted to different purposes in different classes . The foot carries a pair of statocysts , which act as balance sensors . In gastropods , it secretes mucus as a lubricant to aid movement . In forms having only a top shell , such as limpets , the foot acts as a sucker attaching the animal to a hard surface , and the vertical muscles clamp the shell down over it ; in other molluscs , the vertical muscles pull the foot and other exposed soft parts into the shell . In bivalves , the foot is adapted for burrowing into the sediment ; in cephalopods it is used for jet propulsion , and the tentacles and arms are derived from the foot .

= = = Circulatory system = = =

Molluscs ' circulatory systems are mainly open . Although molluscs are coelomates , their coeloms are reduced to fairly small spaces enclosing the heart and gonads . The main body cavity is a hemocoel through which blood and coelomic fluid circulate and which encloses most of the other internal organs . These hemocoelic spaces act as an efficient hydrostatic skeleton . The blood contains the respiratory pigment hemocyanin as an oxygen @-@ carrier . The heart consists of one or more pairs of atria ( auricles ) , which receive oxygenated blood from the gills and pump it to the ventricle , which pumps it into the aorta ( main artery ) , which is fairly short and opens into the hemocoel .

The atria of the heart also function as part of the excretory system by filtering waste products out of the blood and dumping it into the coelom as urine . A pair of nephridia ( " little kidneys " ) to the rear

of and connected to the coelom extracts any re @-@ usable materials from the urine and dumps additional waste products into it , and then ejects it via tubes that discharge into the mantle cavity .

= = = Respiration = = =

Most molluscs have only one pair of gills , or even only one gill . Generally , the gills are rather like feathers in shape , although some species have gills with filaments on only one side . They divide the mantle cavity so water enters near the bottom and exits near the top . Their filaments have three kinds of cilia , one of which drives the water current through the mantle cavity , while the other two help to keep the gills clean . If the osphradia detect noxious chemicals or possibly sediment entering the mantle cavity , the gills ' cilia may stop beating until the unwelcome intrusions have ceased . Each gill has an incoming blood vessel connected to the hemocoel and an outgoing one to the heart .

= = = Eating , digestion , and excretion = = =

Members of the mollusk family use intracellular digestion to function . Most molluscs have muscular mouths with radulae , " tongues " , bearing many rows of chitinous teeth , which are replaced from the rear as they wear out . The radula primarily functions to scrape bacteria and algae off rocks , and is associated with the odontophore , a cartilaginous supporting organ . The radula is unique to the molluscs and has no equivalent in any other animal .

Molluscs ' mouths also contain glands that secrete slimy mucus , to which the food sticks . Beating cilia ( tiny " hairs " ) drive the mucus towards the stomach , so the mucus forms a long string called a " food string " .

At the tapered rear end of the stomach and projecting slightly into the hindgut is the prostyle , a backward @-@ pointing cone of feces and mucus , which is rotated by further cilia so it acts as a bobbin , winding the mucus string onto itself . Before the mucus string reaches the prostyle , the acidity of the stomach makes the mucus less sticky and frees particles from it .

The particles are sorted by yet another group of cilia , which send the smaller particles , mainly minerals , to the prostyle so eventually they are excreted , while the larger ones , mainly food , are sent to the stomach 's cecum ( a pouch with no other exit ) to be digested . The sorting process is by no means perfect .

Periodically , circular muscles at the hindgut 's entrance pinch off and excrete a piece of the prostyle , preventing the prostyle from growing too large . The anus , in the part of the mantle cavity , is swept by the outgoing " lane " of the current created by the gills . Carnivorous molluscs usually have simpler digestive systems .

As the head has largely disappeared in bivalves , the mouth has been equipped with labial palps ( two on each side of the mouth ) to collect the detritus from its mucus .

= = = Nervous system = = =

The cephalic molluscs have two pairs of main nerve cords organized around a number of paired ganglia , the visceral cords serving the internal organs and the pedal ones serving the foot . Most pairs of corresponding ganglia on both sides of the body are linked by commissures ( relatively large bundles of nerves ) . The ganglia above the gut are the cerebral , the pleural , and the visceral , which are located above the esophagus ( gullet ) . The pedal ganglia , which control the foot , are below the esophagus and their commissure and connectives to the cerebral and pleural ganglia surround the esophagus in a circumesophageal nerve ring or nerve collar .

The acephalic molluscs ( bivalves ) also have this ring but it is less obvious and less important . The bivalves have only three pairs of ganglia ? cerebral , pedal , and visceral ? with the visceral as the largest and most important of the three functioning as the principal center of " thinking " . Some such as the scallops have eyes around the edges of their shells which connect to a pair of looped nerves and which provide the ability to distinguish between light and shadow .

## == = Reproduction == =

The simplest molluscan reproductive system relies on external fertilization , but with more complex variations . All produce eggs , from which may emerge trochophore larvae , more complex veliger larvae , or miniature adults . Two gonads sit next to the coelom , a small cavity that surrounds the heart , into which they shed ova or sperm . The nephridia extract the gametes from the coelom and emit them into the mantle cavity . Molluscs that use such a system remain of one sex all their lives and rely on external fertilization . Some molluscs use internal fertilization and / or are hermaphrodites , functioning as both sexes ; both of these methods require more complex reproductive systems .

The most basic molluscan larva is a trochophore , which is planktonic and feeds on floating food particles by using the two bands of cilia around its " equator " to sweep food into the mouth , which uses more cilia to drive them into the stomach , which uses further cilia to expel undigested remains through the anus . New tissue grows in the bands of mesoderm in the interior , so the apical tuft and anus are pushed further apart as the animal grows . The trochophore stage is often succeeded by a veliger stage in which the prototroch , the " equatorial " band of cilia nearest the apical tuft , develops into the velum ( " veil " ) , a pair of cilia @-@ bearing lobes with which the larva swims . Eventually , the larva sinks to the seafloor and metamorphoses into the adult form . While metamorphosis is the usual state in molluscs , the cephalopods differ in exhibiting direct development : the hatchling is a ' miniaturized ' form of the adult .

## == = Ecology == =

## == = Feeding == =

Most molluscs are herbivorous , grazing on algae or filter feeders . For those grazing , two feeding strategies are predominant . Some feed on microscopic , filamentous algae , often using their radula as a ' rake ' to comb up filaments from the sea floor . Others feed on macroscopic ' plants ' such as kelp , rasping the plant surface with its radula . To employ this strategy , the plant has to be large enough for the mollusc to ' sit ' on , so smaller macroscopic plants are not as often eaten as their larger counterparts . Filter feeders are molluscs that feed by straining suspended matter and food particle from water , typically by passing the water over their gills . Most bivalves are filter feeders .

Cephalopods are primarily predatory , and the radula takes a secondary role to the jaws and tentacles in food acquisition . The monoplacophoran *Neopilina* uses its radula in the usual fashion , but its diet includes protists such as the xenophyophore *Stannophyllum* . Sacoglossan sea @-@ slugs suck the sap from algae , using their one @-@ row radula to pierce the cell walls , whereas dorid nudibranchs and some Vetigastropoda feed on sponges and others feed on hydroids . ( An extensive list of molluscs with unusual feeding habits is available in the appendix of GRAHAM , A. ( 1955 ) . " Molluscan diets " . *Journal of Molluscan Studies* 31 ( 3 ? 4 ) : 144 . . )

## == = Classification == =

Opinions vary about the number of classes of molluscs ; for example , the table below shows eight living classes , and two extinct ones . Although they are unlikely to form a clade , some older works combine the Caudofoveata and solenogasters into one class , the Aplacophora . Two of the commonly recognized " classes " are known only from fossils .

Classification into higher taxa for these groups has been and remains problematic . A phylogenetic study suggests the Polyplacophora form a clade with a monophyletic Aplacophora . Additionally , it suggests a sister taxon relationship exists between the Bivalvia and the Gastropoda .

## == = Evolution == =

## == Fossil record ==

Good evidence exists for the appearance of gastropods , cephalopods and bivalves in the Cambrian period 541 to 485 @. @ 4 million years ago . However , the evolutionary history both of the emergence of molluscs from the ancestral group Lophotrochozoa , and of their diversification into the well @-@ known living and fossil forms , is still vigorously debated .

Debate occurs about whether some Ediacaran and Early Cambrian fossils really are molluscs . *Kimberella* , from about 555 million years ago , has been described by some paleontologists as " mollusc @-@ like " , but others are unwilling to go further than " probable bilaterian " . There is an even sharper debate about whether *Wiwaxia* , from about 505 million years ago , was a mollusc , and much of this centers on whether its feeding apparatus was a type of radula or more similar to that of some polychaete worms . Nicholas Butterfield , who opposes the idea that *Wiwaxia* was a mollusc , has written that earlier microfossils from 515 to 510 million years ago are fragments of a genuinely mollusc @-@ like radula . This appears to contradict the concept that the ancestral molluscan radula was mineralized .

However , the *Helcionellids* , which first appear over 540 million years ago in Early Cambrian rocks from Siberia and China , are thought to be early molluscs with rather snail @-@ like shells . Shelled molluscs therefore predate the earliest trilobites . Although most *helcionellid* fossils are only a few millimeters long , specimens a few centimeters long have also been found , most with more limpet @-@ like shapes . The tiny specimens have been suggested to be juveniles and the larger ones adults .

Some analyses of *helcionellids* concluded these were the earliest gastropods . However , other scientists are not convinced these Early Cambrian fossils show clear signs of the torsion that identifies modern gastropods twists the internal organs so the anus lies above the head .

*Volborthella* , some fossils of which predate 530 million years ago , was long thought to be a cephalopod , but discoveries of more detailed fossils showed its shell was not secreted , but built from grains of the mineral silicon dioxide ( silica ) , and it was not divided into a series of compartments by septa as those of fossil shelled cephalopods and the living *Nautilus* are . *Volborthella* 's classification is uncertain . The Late Cambrian fossil *Plectronoceras* is now thought to be the earliest clearly cephalopod fossil , as its shell had septa and a siphuncle , a strand of tissue that *Nautilus* uses to remove water from compartments it has vacated as it grows , and which is also visible in fossil ammonite shells . However , *Plectronoceras* and other early cephalopods crept along the seafloor instead of swimming , as their shells contained a " ballast " of stony deposits on what is thought to be the underside , and had stripes and blotches on what is thought to be the upper surface . All cephalopods with external shells except the nautiloids became extinct by the end of the Cretaceous period 65 million years ago . However , the shell @-@ less *Coleoidea* ( squid , octopus , cuttlefish ) are abundant today .

The Early Cambrian fossils *Fordilla* and *Pojetaia* are regarded as bivalves . " Modern @-@ looking " bivalves appeared in the Ordovician period , 488 to 443 million years ago . One bivalve group , the *rudists* , became major reef @-@ builders in the Cretaceous , but became extinct in the Cretaceous ? Paleogene extinction event . Even so , bivalves remain abundant and diverse .

The *Hyalitha* are a class of extinct animals with a shell and operculum that may be molluscs . Authors who suggest they deserve their own phylum do not comment on the position of this phylum in the tree of life

## == Phylogeny ==

The phylogeny ( evolutionary " family tree " ) of molluscs is a controversial subject . In addition to the debates about whether *Kimberella* and any of the " *halwaxiids* " were molluscs or closely related to molluscs , debates arise about the relationships between the classes of living molluscs . In fact , some groups traditionally classified as molluscs may have to be redefined as distinct but related .

Molluscs are generally regarded members of the Lophotrochozoa , a group defined by having trochophore larvae and , in the case of living Lophophorata , a feeding structure called a lophophore . The other members of the Lophotrochozoa are the annelid worms and seven marine phyla . The diagram on the right summarizes a phylogeny presented in 2007 .

Because the relationships between the members of the family tree are uncertain , it is difficult to identify the features inherited from the last common ancestor of all molluscs . For example , it is uncertain whether the ancestral mollusc was metameric ( composed of repeating units ) ? if it was , that would suggest an origin from an annelid @-@ like worm . Scientists disagree about this : Giribet and colleagues concluded , in 2006 , the repetition of gills and of the foot 's retractor muscles were later developments , while in 2007 , Sigwart concluded the ancestral mollusc was metameric , and it had a foot used for creeping and a " shell " that was mineralized . In one particular branch of the family tree , the shell of conchiferans is thought to have evolved from the spicules ( small spines ) of aplacophorans ; but this is difficult to reconcile with the embryological origins of spicules .

The molluscan shell appears to have originated from a mucus coating , which eventually stiffened into a cuticle . This would have been impermeable and thus forced the development of more sophisticated respiratory apparatus in the form of gills . Eventually , the cuticle would have become mineralized , using the same genetic machinery ( engrailed ) as most other bilaterian skeletons . The first mollusc shell almost certainly was reinforced with the mineral aragonite .

The evolutionary relationships ' within ' the molluscs are also debated , and the diagrams below show two widely supported reconstructions :

Morphological analyses tend to recover a conchiferan clade that receives less support from molecular analyses , although these results also lead to unexpected paraphylies , for instance scattering the bivalves throughout all other mollusc groups .

However , an analysis in 2009 using both morphological and molecular phylogenetics comparisons concluded the molluscs are not monophyletic ; in particular , Scaphopoda and Bivalvia are both separate , monophyletic lineages unrelated to the remaining molluscan classes ; the traditional phylum Mollusca is polyphyletic , and it can only be made monophyletic if scaphopods and bivalves are excluded . A 2010 analysis recovered the traditional conchiferan and aculiferan groups , and showed molluscs were monophyletic , demonstrating that available data for solenogastres was contaminated . Current molecular data are insufficient to constrain the molluscan phylogeny , and since the methods used to determine the confidence in clades are prone to overestimation , it is risky to place too much emphasis even on the areas of which different studies agree . Rather than eliminating unlikely relationships , the latest studies add new permutations of internal molluscan relationships , even bringing the conchiferan hypothesis into question .

= = Human interaction = =

For millennia , molluscs have been a source of food for humans , as well as important luxury goods , notably pearls , mother of pearl , Tyrian purple dye , sea silk , and chemical compounds . Their shells have also been used as a form of currency in some preindustrial societies . A number of species of molluscs can bite or sting humans , and some have become agricultural pests .

= = = Uses by humans = = =

Molluscs , especially bivalves such as clams and mussels , have been an important food source since at least the advent of anatomically modern humans , and this has often resulted in overfishing . Other commonly eaten molluscs include octopuses and squids , whelks , oysters , and scallops . In 2005 , China accounted for 80 % of the global mollusc catch , netting almost 11 @,@ 000 @,@ 000 tonnes ( 11 @,@ 000 @,@ 000 long tons ; 12 @,@ 000 @,@ 000 short tons ) . Within Europe , France remained the industry leader . Some countries regulate importation and handling of molluscs and other seafood , mainly to minimize the poison risk from toxins that can sometimes accumulate in the animals .

Most molluscs with shells can produce pearls , but only the pearls of bivalves and some gastropods

, whose shells are lined with nacre , are valuable . The best natural pearls are produced by marine pearl oysters , *Pinctada margaritifera* and *Pinctada mertensi* , which live in the tropical and subtropical waters of the Pacific Ocean . Natural pearls form when a small foreign object gets stuck between the mantle and shell .

The two methods of culturing pearls insert either " seeds " or beads into oysters . The " seed " method uses grains of ground shell from freshwater mussels , and overharvesting for this purpose has endangered several freshwater mussel species in the southeastern USA . The pearl industry is so important in some areas , significant sums of money are spent on monitoring the health of farmed molluscs .

Other luxury and high @-@ status products were made from molluscs . Tyrian purple , made from the ink glands of murex shells , " ... fetched its weight in silver " in the fourth century BC , according to Theopompus . The discovery of large numbers of Murex shells on Crete suggests the Minoans may have pioneered the extraction of " imperial purple " during the Middle Minoan period in the 20th ? 18th centuries BC , centuries before the Tyrians . Sea silk is a fine , rare , and valuable fabric produced from the long silky threads ( byssus ) secreted by several bivalve molluscs , particularly *Pinna nobilis* , to attach themselves to the sea bed . Procopius , writing on the Persian wars circa 550 CE , " stated that the five hereditary satraps ( governors ) of Armenia who received their insignia from the Roman Emperor were given chlamys ( or cloaks ) made from lana pinna . Apparently , only the ruling classes were allowed to wear these chlamys . "

Mollusc shells , including those of cowries , were used as a kind of money ( shell money ) in several preindustrial societies . However , these " currencies " generally differed in important ways from the standardized government @-@ backed and -controlled money familiar to industrial societies . Some shell " currencies " were not used for commercial transactions , but mainly as social status displays at important occasions , such as weddings . When used for commercial transactions , they functioned as commodity money , as a tradable commodity whose value differed from place to place , often as a result of difficulties in transport , and which was vulnerable to incurable inflation if more efficient transport or " goldrush " behavior appeared .

= = = = Bioindicators = = = =

Bivalve molluscs are used as bioindicators to monitor the health of aquatic environments in both fresh water and the marine environments . Their population status or structure , physiology , behaviour or the level of contamination with elements or compounds can indicate the state of contamination status of the ecosystem . They are particularly useful since they are sessile so that they are representative of the environment where they are sampled or placed . A typical project is the Mussel Watch Programme but today they are used worldwide .

= = = = Stings and bites = = = =

A risk of food poisoning from toxins that accumulate in molluscs occurs under certain conditions , and many countries have regulations that aim to minimize this risk . Blue @-@ ringed octopus bites are often fatal , and the bite of other octopuses can cause unpleasant symptoms . Stings from a few species of large tropical cone shells can also kill . However , the sophisticated venoms of these cone snails have become important tools in neurological research and show promise as sources of new medications .

When handled alive , a few species of molluscs can sting or bite and , with some species , this can present a serious risk to the human handling the animal . To put this into perspective , though , deaths from mollusc venoms are less than 10 % of the number of deaths from jellyfish stings .

All octopuses are venomous , but only a few species pose a significant threat to humans . Blue @-@ ringed octopuses in the genus *Hapalochlaena* , which live around Australia and New Guinea , bite humans only if severely provoked , but their venom kills 25 % of human victims . Another tropical species , *Octopus apollyon* , causes severe inflammation that can last for over a month even if treated correctly , and the bite of *Octopus rubescens* can cause necrosis that lasts longer than one



month if untreated , and headaches and weakness persisting for up to a week even if treated .

All species of cone snails are venomous and can sting when handled , although many species are too small to pose much of a risk to humans . These carnivorous gastropods feed on marine invertebrates ( and in the case of larger species , on fish ) . Their venom is based on a huge array of toxins , some fast @-@ acting and others slower but deadlier ; they can afford to do this because their toxins require less time and energy to be produced compared with those of snakes or spiders . Many painful stings have been reported , and a few fatalities , although some of the reported fatalities may be exaggerations . Only a few larger species of cone snails which can capture and kill fish are likely to be seriously dangerous to humans . The effects of individual cone @-@ shell toxins on victims ' nervous systems are so precise as to be useful tools for research in neurology , and the small size of their molecules makes it easy to synthesize them .

The traditional belief that a giant clam can trap the leg of a person between its valves , thus causing drowning , is a myth .

= = = = Parasites = = = =

Schistosomiasis ( also known as bilharzia , bilharziosis or snail fever ) is transmitted to humans via water snail hosts , and affects about 200 million people . A few species of snails and slugs are serious agricultural pests ; in addition , accidental or deliberate introduction of various snail species into new territory has resulted in serious damage to some natural ecosystems .

Schistosomiasis , a disease caused by the fluke worm *Schistosoma* , is " second only to malaria as the most devastating parasitic disease in tropical countries . An estimated 200 million people in 74 countries are infected with the disease ? 100 million in Africa alone . " The parasite has 13 known species , two of which infect humans . The parasite itself is not a mollusc , but all the species have freshwater snails as intermediate hosts .

= = = = Pests = = = =

Some species of molluscs , particularly certain snails and slugs , can be serious crop pests , and when introduced into new environments , can unbalance local ecosystems . One such pest , the giant African snail *Achatina fulica* , has been introduced to many parts of Asia , as well as to many islands in the Indian Ocean and Pacific Ocean . In the 1990s , this species reached the West Indies . Attempts to control it by introducing the predatory snail *Euglandina rosea* proved disastrous , as the predator ignored *Achatina fulica* and went on to extirpate several native snail species , instead .

Despite its name , *Molluscum contagiosum* is a viral disease , and is unrelated to molluscs .