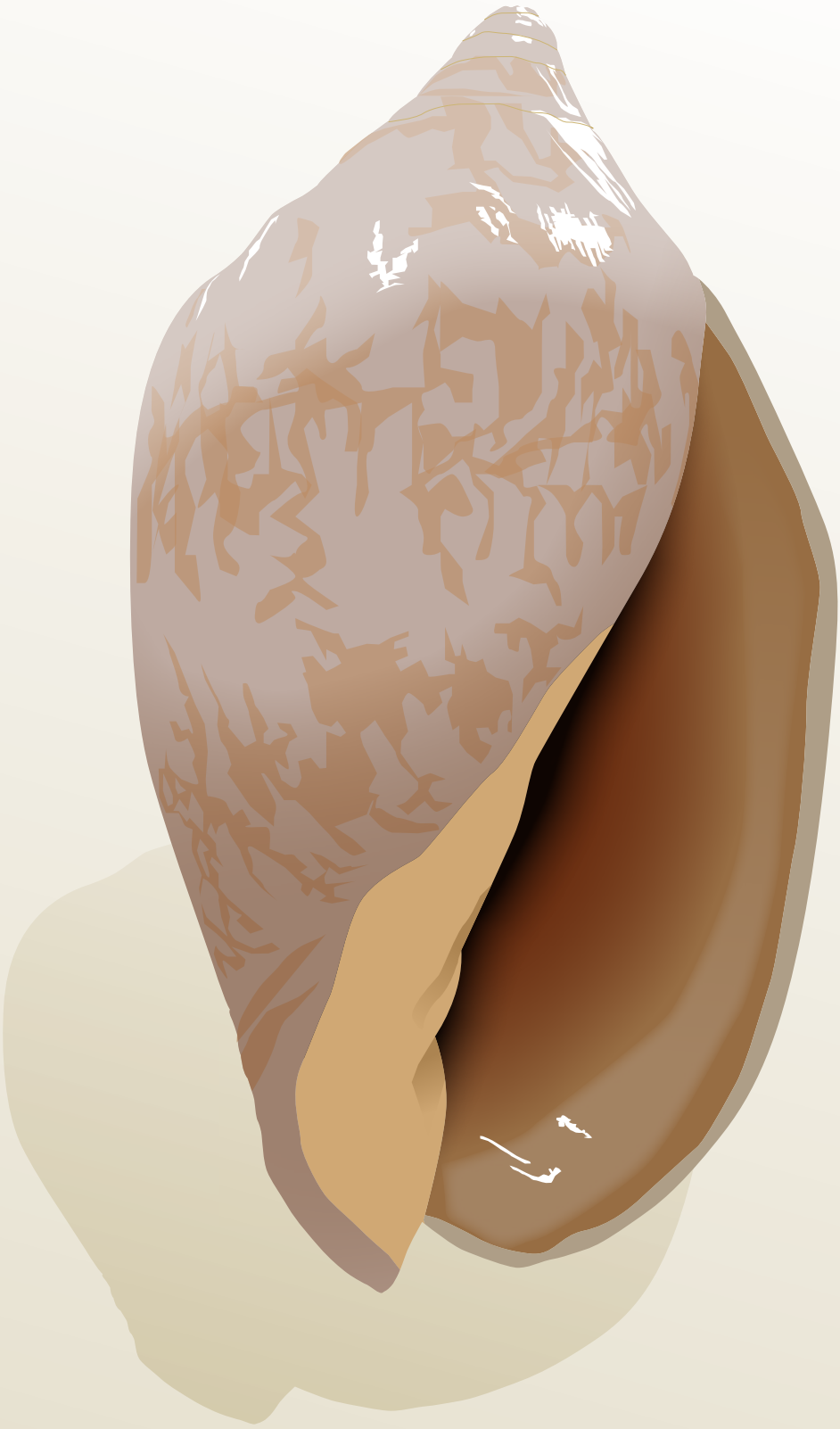


Shell Classification

USING FAMILY PLATES

YEAR SEVEN STUDENTS

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM NETWORK | Queensland Government

Introduction

The Queensland Museum Network has about 2.5 million biological specimens, and these items form the Biodiversity collections. Most specimens are from Queensland's terrestrial and marine provinces, but some are from adjacent Indo-Pacific regions. A smaller number of exotic species have also been acquired for comparative purposes. The collection steadily grows as our inventory of the region's natural resources becomes more comprehensive.

This collection helps scientists:

- identify and name species
- understand biodiversity in Australia and around the world
- study evolution, connectivity and dispersal throughout the Indo-Pacific
- keep track of invasive and exotic species.

Many of the scientists who work at the Museum specialise in taxonomy, the science of describing and naming species. In fact, Queensland Museum scientists have played a role in discovering more than 4000 new species since 1862!

In the following activity you and your class can use the same techniques as Queensland Museum scientists to classify organisms.

Activity: Identifying Queensland shells by family. These 20 plates show common Queensland shells from 38 different families, and can be used for a range of activities both in and outside the classroom.

Possible uses of this resource include:

- students finding shells and identifying what family they belong to
- students determining what features shells in each family share
- students comparing families to see how they differ.

All shells shown on the following plates are from the Queensland Museum Biodiversity Collection.

Year 7 Australian Curriculum Links for this Resource

Science Understanding (SU)

Classification helps organise the diverse group of organisms (ACSSU111)

Science Inquiry Skills (SIS)

Processing and analysing data and information

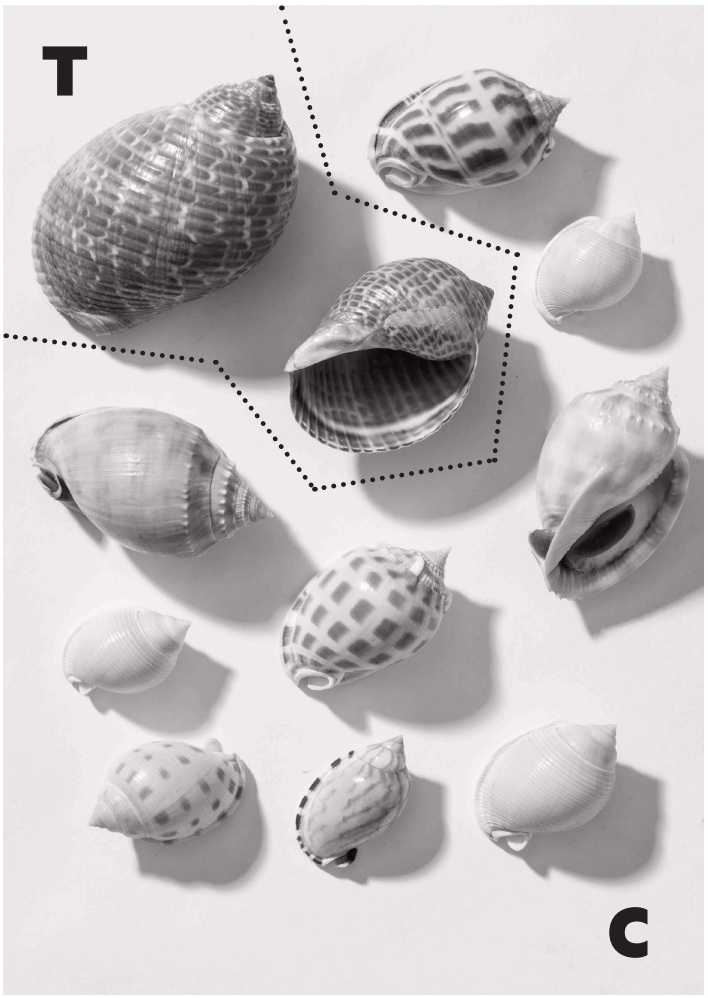
Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS129)

As this resource has been designed to complement classroom-based teaching and learning experiences, students are assumed to have developed knowledge about the following concepts:

- classification involves grouping organisms based on similarities and differences.
- biological classification uses a hierarchical system, including kingdom, phylum, class, order, family, genus and species.
- species have binomial (two-part) scientific names.
- dichotomous keys can be used to help identify specimens.

Future Makers is an innovative partnership between Queensland Museum Network and Shell's QGC project aiming to increase awareness and understanding of the value of science, technology, engineering and maths (STEM) education and skills in Queensland.

This partnership aims to engage and inspire people with the wonder of science, and increase the participation and performance of students in STEM-related subjects and careers — creating a highly capable workforce for the future.

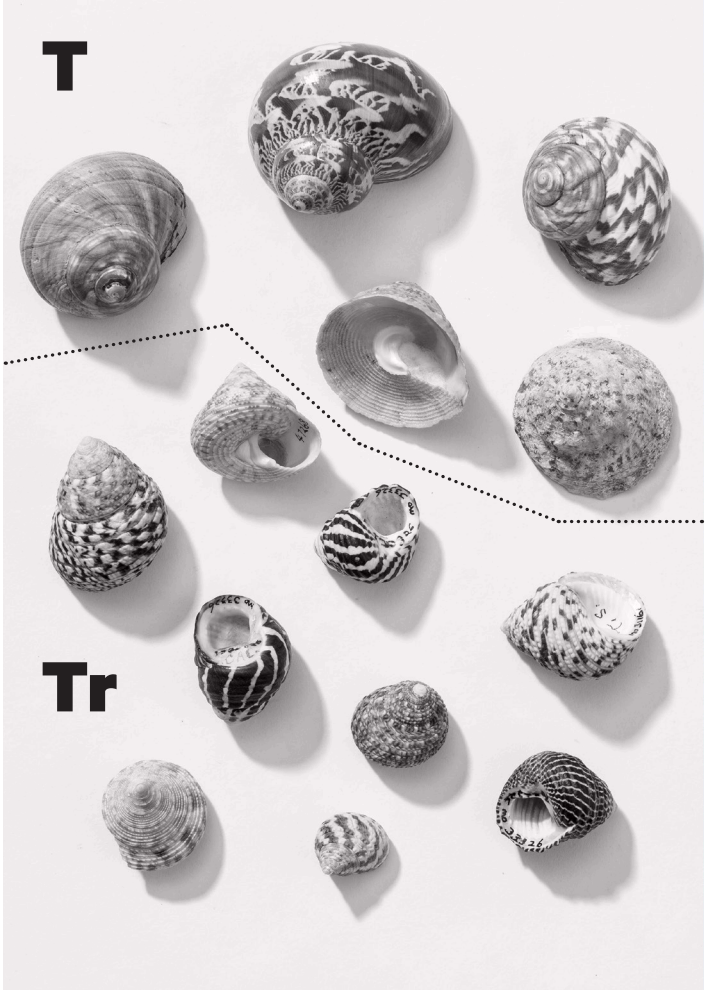


T – Tonnidae
C – Cassidae

Tonnidae (Tuns) & Cassidae (Helmets)

Tuns are generally found on sandy substrates in shallow to deep water. They are predators of creatures such as echinoderms, crustaceans and bivalves. Some tun species feed by swallowing sea cucumbers whole! Tuns kill their prey using a salivary secretion that contains sulphuric acid.

Helmets are also found in sandy habitats where they burrow into the substrate. They usually feed at night on echinoderms such as sea urchins and starfish. When feeding on sea urchins, helmets use an acid secretion to dissolve spines away, then drill through the shell and suck out the animal!



T – Turbinidae
Tr – Trochidae

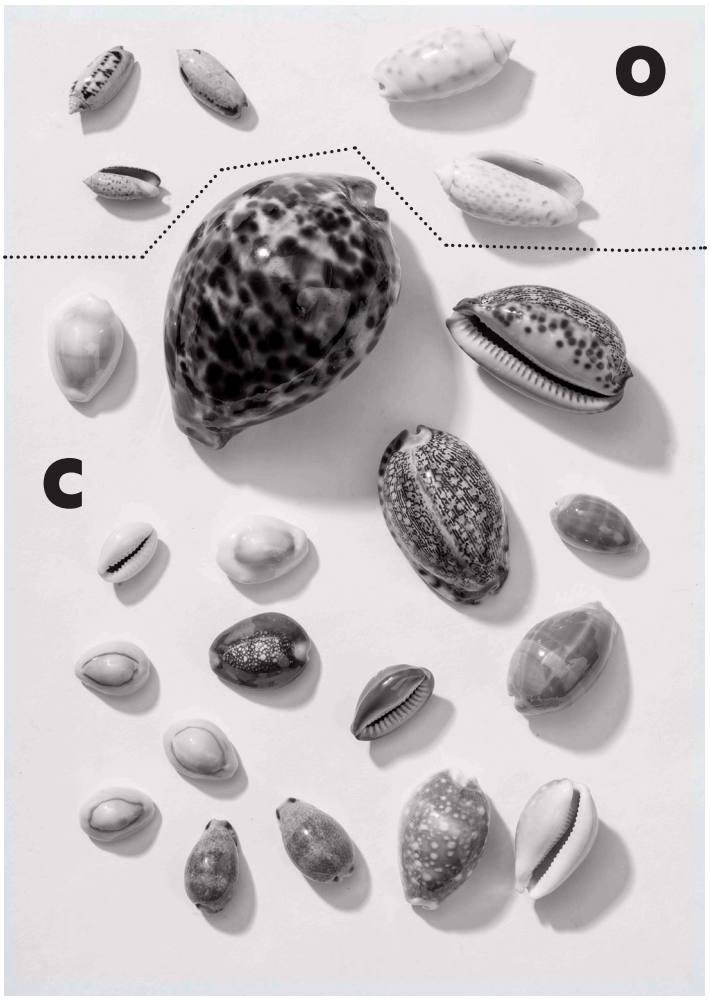
Turban shell.
Image: QM, Peter Waddington

Operculum

Turbinidae (Turbans) & Trochidae (Top Snails)

Turbans are herbivores that graze on algae from rocks using their toothed tongue (known as a radula). Their operculum (a door-like cover to the aperture that is attached to and secreted by the foot) is solid, calcified and is often referred to as a 'cat's eye' because of its appearance.

Top snails are so named because their conical, pointed shape resembles a spinning top. These molluscs are also grazers of algae. Like turbans, top snail shells are lined with mother-of-pearl. Also called nacre, this product has been used in many commercial products, including jewellery and buttons. As a result, some species (e.g. the Giant Top Snail) have been overharvested, and more sustainable practices are now being investigated.



O – Olividae
C – Cypraeidae

Olividae (Olives) & Cypraeidae (Cowries)

Olives live in sandy substrates where they are both scavengers and predators of small crustaceans and bivalves. When hunting, olives burrow into the sand, leaving their siphons projecting above the surface to detect the scent of their prey. Then the olive emerges, smothers the victim with slime and drags it below to consume it. Their distinctive feeding trails can often be seen on sandy beaches in the intertidal zone.

Cowries feed on a variety of different organisms; some graze on algae whereas others prey on sponges, lace corals and other invertebrates. Throughout history, cowries have been highly prized by humans, and some (e.g. the Money Cowrie) have been used as currency throughout Africa, Asia and the Pacific islands. Both olives and cowries partially envelop their shells with mantle tissue, which gives the shell surface an attractive glossy appearance.

Conidae (Cone Snails)

Cone snails are well-known and prized for their distinctive and elaborately-patterned shells. Interestingly, these molluscs are also highly specialised predators that have modified, harpoon-like radular teeth. When hunting, cone snails fire these teeth into prey, which may be worms, molluscs or fishes. Cone snail venom, delivered via the tooth, is known to quickly immobilize prey. The venom of some species can even be deadly to humans. Ironically, medical researchers are utilising the compounds in these venoms for pain relief in humans.

WARNING: cone shells should not be handled, as some species are dangerous to humans and fatalities have occurred. A cone shell on the beach may still have a living animal inside; one in the water is almost certainly still alive. Use a stick if you are curious, or better still, leave it alone!

Blood-red volute
Image: QM, Gary Cranitch.

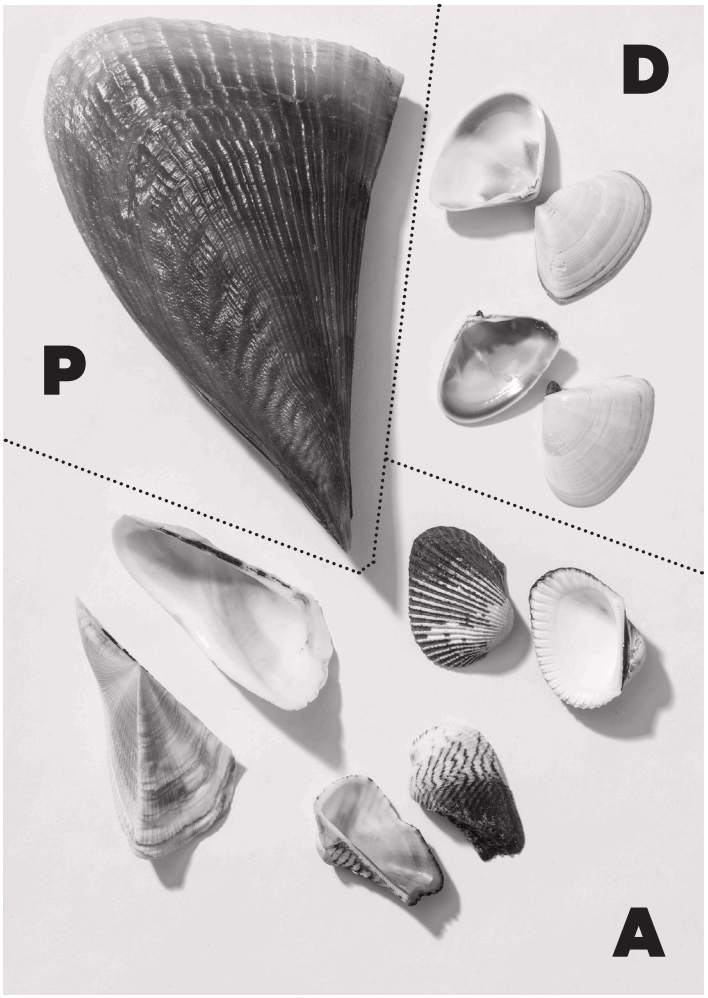
Columellar folds

Volutidae (Volutes)

Volute shells are often glossy and beautifully patterned with stripes and blotches. The name volute comes from *voluta*, a word meaning “spiral” in Latin, and refers to the columellar folds inside the aperture of many volute species (see picture below left). Volutes are active hunters that feed on other marine snails, bivalves, hermit crabs and echinoderms. They use their siphon to seek out prey, and then smother prey with their foot before consuming it. The largest shell shown on the plate, the Common Baler, is so named because Aboriginal people historically used this species to store water and to bail out canoes.

Strombidae (Strombs/Conchs)

Stromb shells vary in size, from small objects you can hold in your palm, to giant conchs that reach 40 cm in length. Big or small, strombs have a shell with a flared outer lip that helps prevent them from rolling over in the surf or current. Strombs have another feature that helps them get around: sophisticated eyes on the end of eyestalks, which give them good vision. If the eyestalk is cut the stromb can even grow a new eye! Strombs use their eyesight to avoid predators, and find algae and detritus to feed on. Strombs in turn are eaten by people in many parts of the world, and at least one species, the Queen Conch, is now threatened due to overharvesting.



D – Donacidae **A** – Arcidae
P – Pinnidae

Ark Clam –
internal view
Image: QM, Gary Cranitch.

Donacidae (Pipis) & Arcidae (Ark Clams) & Pinnidae (Pen or Razor Clams)

Surf clams live on exposed surf beaches, as their name implies. This family includes pipis, which are found around Australia. Pipis burrow in the sand and filter seawater for particles of food; if dislodged by a wave, pipis can rapidly dig themselves back into the sand, aided by their foot and their smooth, wedge-shaped shells. Pipis are widely used for food and bait, but their harvesting is regulated.

Arks or ark clams are named for the flat area where the valves join. This “straight line,” shown to the left, gives the entire shell the outline of a ship or an ark.

Interestingly, some ark clams are red in colour because they possess haemoglobin, a protein normally found in the blood of vertebrates. This haemoglobin helps ark clams absorb oxygen in low-oxygen environments.

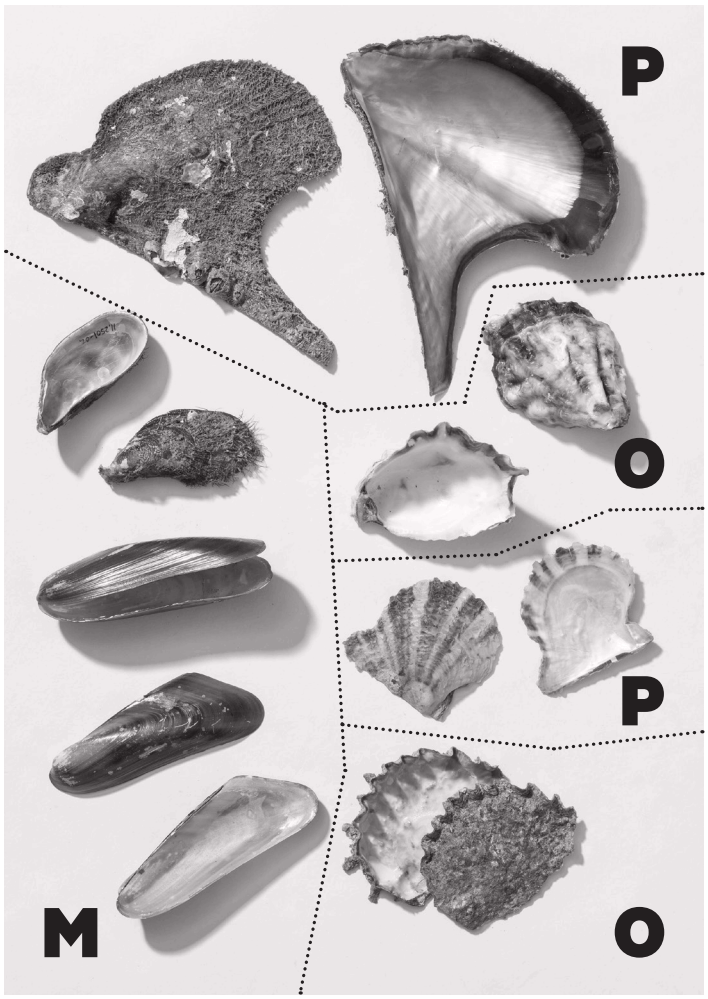
Pen clams or razor clams have elongate shells and stay buried in the sand or mud, with just the top of the shell protruding. These protruding tops can be hazardous to people walking in bare feet and can easily cut skin, hence the name razor clams. To stay anchored in the sediment these clams produce fibers at the base of the shell; these fibers, known as byssal filaments, are very fine and can be made into fabric known as sea silk.

M – Mactridae
V – Veneridae

Mactridae (Trough Clams) & Veneridae (Venus Clams)

Trough clams are borrowing bivalves that live along coasts and in estuaries. Like other clams, mactrids are filter feeders. One species (*Spisula trigonella*) is perhaps the most common bivalve in Moreton Bay; material from these shells is a significant component of shell grit found on local beaches.

Venus clams include some of the most colourful bivalve species. These filter feeders burrow in a variety of habitats, including sand, mud, corals, reefs and mangroves. Predators of venus clams include sand snails, murex snails, stingrays and wader birds. Venus clams are also eaten by people in many parts of the world.



P – Pteriidae **O** – Ostreidae
M – Mytilidae

Pteriidae (Pearl Oysters) & Ostreidae (True Oysters) & Mytilidae (Mussels)

Pearl oysters are most common in tropical and subtropical areas, and live in a variety of habitats, including sand, mud, rock, coral and seagrass. These bivalves are best known for producing pearls, which have been prized throughout human history. A pearl forms when a particle of sand, debris or even a parasite gets inside the shell of an oyster and causes irritation. In response the oyster coats the object with mother-of-pearl, also called nacre. Pearls are not just white and round; they can come in many shapes, sizes and colours.

True oysters live in seawater and salty river water, and can be found along the coast, and in estuaries and rivers. These oysters inhabit the intertidal and subtidal zones, attaching themselves to rocks or other hard objects using a sticky cement-like substance. When the tide is high submerged oysters open their shells, feeding on organic material they filter out of the water. When the tide is low exposed oysters do not feed, instead keeping their shells closed. These bivalves are edible and have been eaten for thousands of years; the ancient Romans cultivated oysters and even considered them a delicacy.

Like the true oysters, mussels are filter feeders that live in the intertidal or subtidal zones. Mussels attach themselves to objects using a network of threads called a byssus. These threads (and oyster “cement”) are amazing: they act like a glue that works under water! In edible mussels the byssus is commonly called a beard, and mussels have to be “debearded” before they are cooked.

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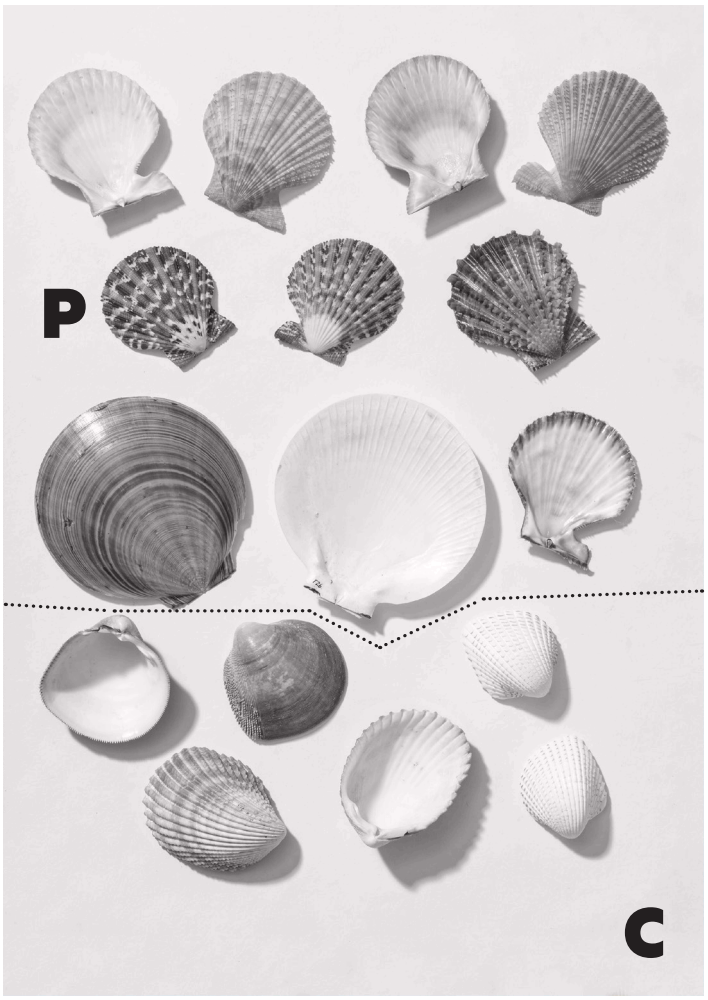
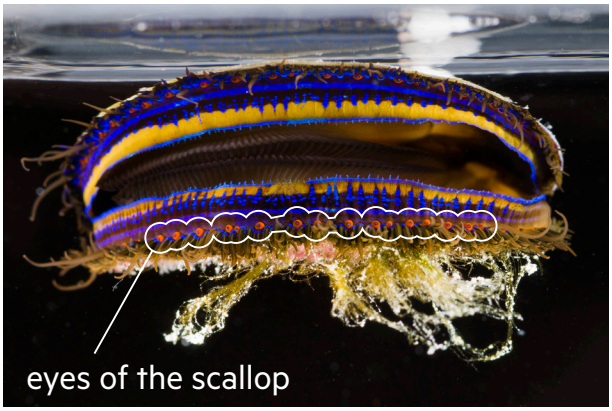


P – Pectinidae
C – Cardiidae

Living scallop in a tank.
Image: QM, Gary Cranitch.



Pectinidae (Scallops) & Cardiidae (Cockles)

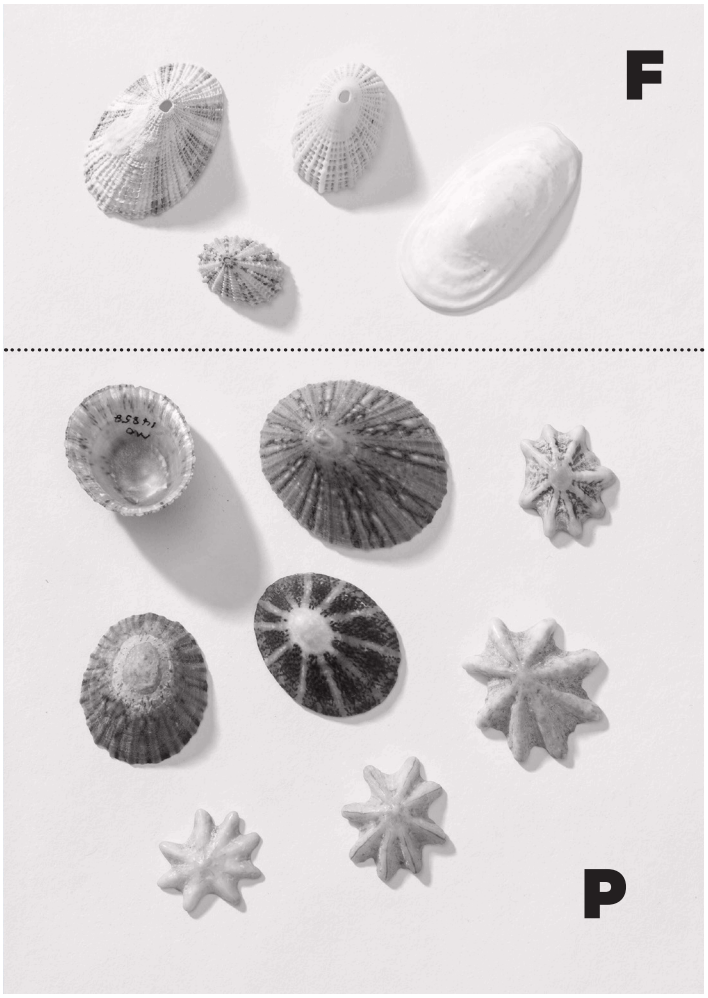
Cockles have a heart-shaped shell, and the name cockle may come from the Latin word *corculum*, meaning "little heart." Cockles are bivalves that burrow into sand or mud and feed on plankton they have filtered out of the water.

Scallops are familiar to people for many reasons. These bivalves are found around the world, and their brightly coloured shells have a distinctive shape that is easily recognisable. In fact, scallop shell designs have been used in artwork throughout history, including ancient Greek sculptures and Roman mosiacs. People have also consumed scallops for thousands of years, a trend that continues today. When you eat scallops in a seafood dish, you are usually only eating the adductor muscle that holds the valves closed.

Scallops are unusual bivalves because many species can actively swim. These species open and close their valves, forcing water out and creating jet propulsion. This behaviour allows scallops to escape from predators like starfish. Scallops also detect predators by using the many simple eyes located on their mantle. These eyes give the scallop a remarkable appearance that can be seen in the picture to the left. The orange dots are the eyes of the scallop and the bright blue and yellow tissue is part of the mantle, the organ that secretes the shell.

Naticidae (Sand Snails)

Sand snails live in in the intertidal zone, where they hunt for other molluscs. They envelop prey with their large foot, and use their radula (a toothed tongue) to drill a hole into their prey's shell. Once this is done the snail can stick its proboscis through the hole and use its radular teeth to consume its meal! Sand snails also lay distinctive egg masses such as sand collars or curved jelly crescents. These can be often seen at low tide on beaches or mud flats in Queensland.

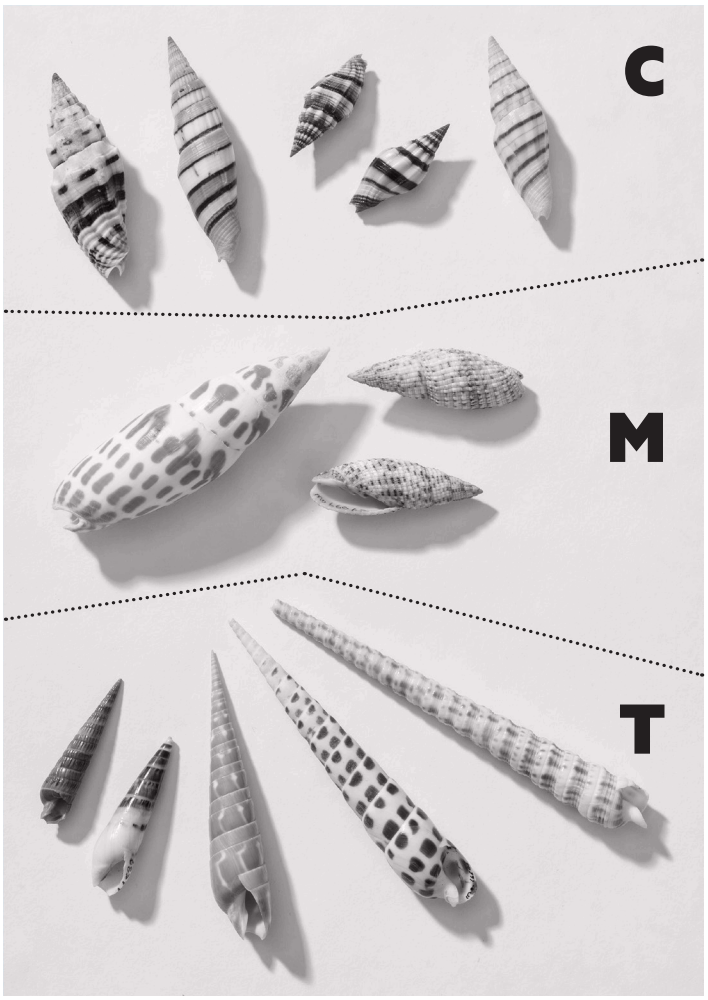


F – Fissurellidae
P – Patellidae

Fissurellidae (Keyhole Limpets) & Patellidae (True Limpets)

Keyhole limpets live in the intertidal zone. Their conical shell shape helps absorb the impact of waves, and the “keyhole” at the top allows waste to be excreted. These molluscs feed on algae or detritus that they scrape off rocks.

Like keyhole limpets, true limpets live in the intertidal zone, and have a conical shell shape that helps absorb wave impact. True limpets also graze on algae or detritus. Unlike keyhole limpets, however, patellids excrete their waste via an opening below the shell.



C – Costellariidae **M** – Mitridae
T – Terebridae

Mitridae (Mitres) & Costellariidae (Ribbed Mitres) & Terebridae (Auger Snails)

Mitres have narrow, pointed shells and are named after mitres, tall hats worn by bishops. Mitres live in the intertidal and subtidal zones in sand or coral, and can often be found on the underside of rocks or coral boulders. Many mitres feed on sipunculid worms.

Ribbed mitres look similar to mitres, but have extra ribs or grooves on their shells. Ribbed mitres live in sand and coral at a variety of depths. They are predatory, and some species feed on other molluscs, producing a venom that quickly kills their prey.

Auger snails have very elongate shells, and are named for their resemblance to augers, drills that have been used since the Iron Age (about 3000 years ago). Auger snails live in sandy habitats in the intertidal and subtidal zones, where they feed on worms. Some auger snails inject their prey with venom, while others swallow their prey whole!

N – Neritidae
L – Littorinidae

Neritidae (Nerites) & Littorinidae (Periwinkles)

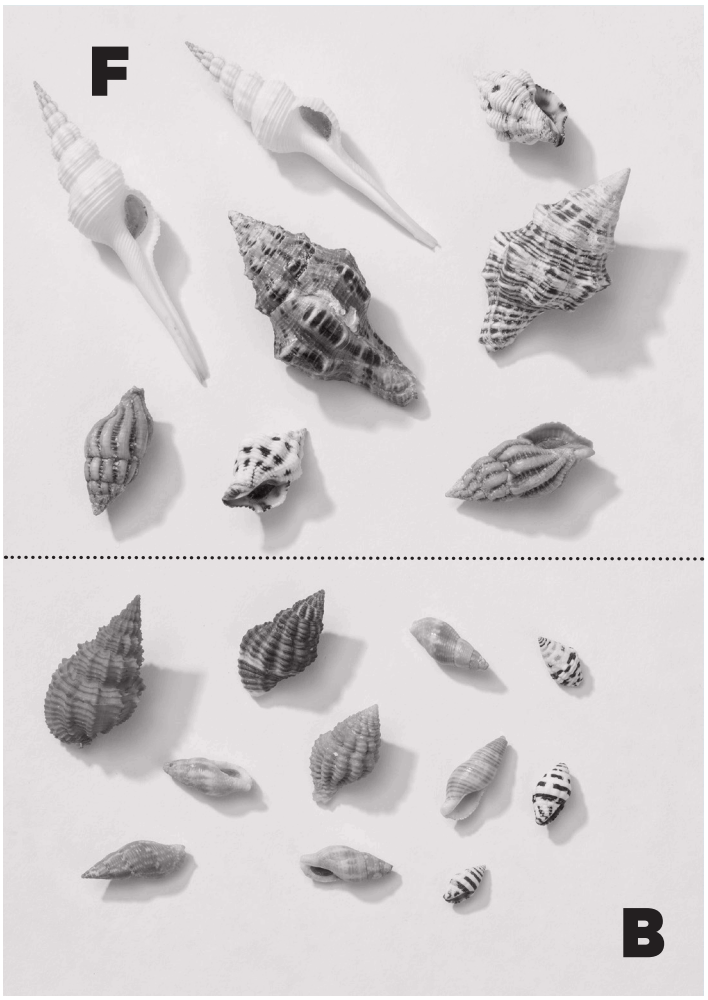
Nerites are named after Nerites, a Greek sea god. These small molluscs live in the intertidal zone on rocks and mangroves, where they graze on algae. Nerites are most active when the tide is rising or falling, and are inactive at high and low tide. During the day nerites often cluster together to stay cool, usually between large boulders or rock crevices.

Periwinkles live in the intertidal zone of rocky shores, where they graze on algae. Some periwinkles also live on mangroves. These molluscs are edible and have been eaten in Europe for thousands of years. The name “periwinkle” may come from the term “pin winkle,” because people used pins to pull these molluscs from their shells before consuming them. (The suffix winkle comes from an Old English word “wincle,” meaning shell.)

Muricidae (Murex Snails/Oyster Drills/ Rock Whelks)

The Muricidae is one of the largest families of marine snails, with more than 1,000 species. Given their numbers, it is no surprise that murex snails have a great diversity of form, as can be seen on the plate. Murex shells often feature sharp spines, probably a form of protection from predators. Murex snails are commonly found in shallow to deep tropical and subtropical waters. All muricids are predatory, consuming a variety of prey including barnacles, crustaceans, worms and other molluscs. Like sand snails, murex snails drill holes into the shells of their prey. Some species even eat coral!

Murex snails have a long history with humans: Aristotle wrote about them more than 2,000 years ago, giving them the name “murex.” These snails were used to manufacture the famous Tyrian purple dye, which was used to colour the clothing of emperors and popes. This dye was very labour-intensive to make; thousands of shells were needed just to extract enough dye to colour one garment! To produce Tyrian purple, snails had to be collected and left in vats to rot, making a stench that was so bad, it stuck to everything and everyone involved. In some places women were given a specific right to divorce husbands who became dye-makers!

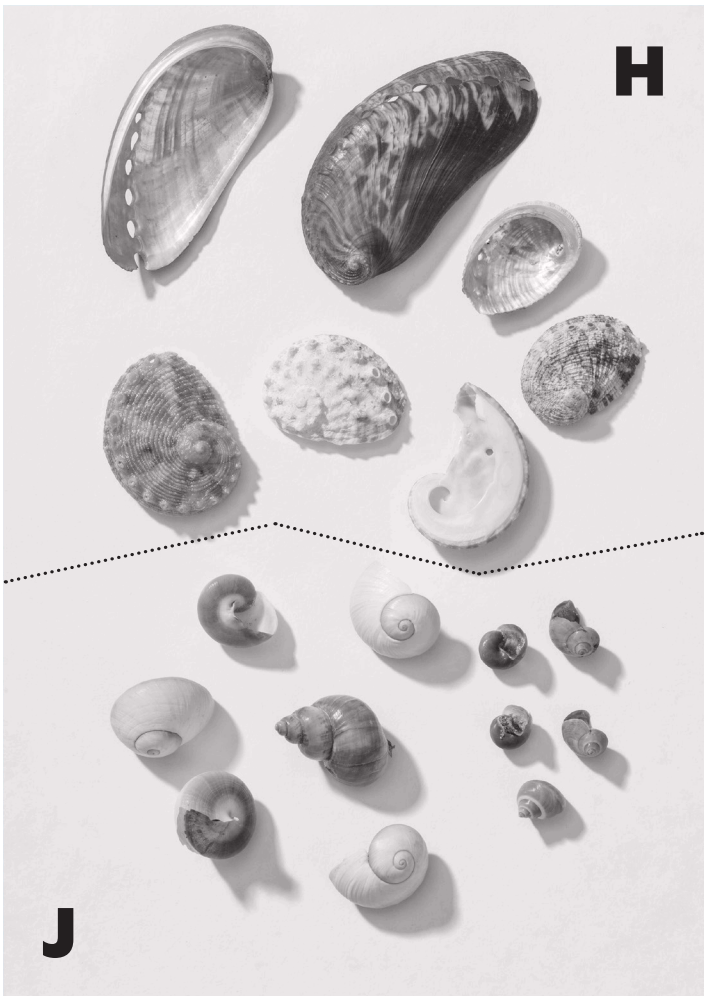


F – Fasciolariidae
B – Buccinidae

Fasciolariidae (Spindle Whelks) & Buccinidae (True Whelks/Goblet Snails)

Spindle whelks have long and narrow shells (see especially the top left of the plate), and are named after spindles, spikes used to help spin thread. Spindle whelks are found in the intertidal zone to deep water, in sand, rocks and coral reefs. These whelks are carnivores and scavengers, with some species feeding on other molluscs, mollusc eggs and even shark eggs.

Buccinids or true whelks are found in the intertidal and subtidal zones, with some species also occurring in deeper waters. These molluscs live in sand, rocks or coral, and are predators or scavengers. While buccinids are common in tropical and subtropical waters, some species can be found in polar regions as well, including Antarctica.



H – Haliotidae
J – Janthinidae

Haliotidae (Abalone) & Janthinidae (Violet Snails)

Abalone shells are immediately recognisable by the line of holes that extends across them. These holes are called “tremata” and are used by the living animal for respiration. Abalone live on rocky surfaces in the intertidal and subtidal zones, where they graze on algae. Because these molluscs are edible, and their shells are used as a source of mother-of-pearl, abalone constitute a valuable industry. They are farmed in Australia, and wild abalone are also collected by divers. Diving for abalone is one of the most dangerous jobs in the world, as many divers haven been taken by sharks!

Violet snails live in the open ocean. These molluscs hang upside down on the surface of the water, floating on a raft of bubbles that they produce. Violet snails feed on siphonophores, jellyfish-like organisms that include blue bottles and the Portuguese man o’ war. Some violet snails actually attach to their “jellyfish” prey and feed on it as they float along. Violet snails are named because many species have purple shells.

C – Cerithiidae
B – Batillariidae

Cerithiidae (Sand Creepers) & Batillariidae (Mud Whelks)

Sand creepers live in a variety of habitats in shallow to deep water. Many species feed on algae and detritus. One species (*Clypeomorus batillariaeformis*) is common on Heron Island on the Great Barrier Reef, where it plays a role in transmitting parasitic worms to fish.

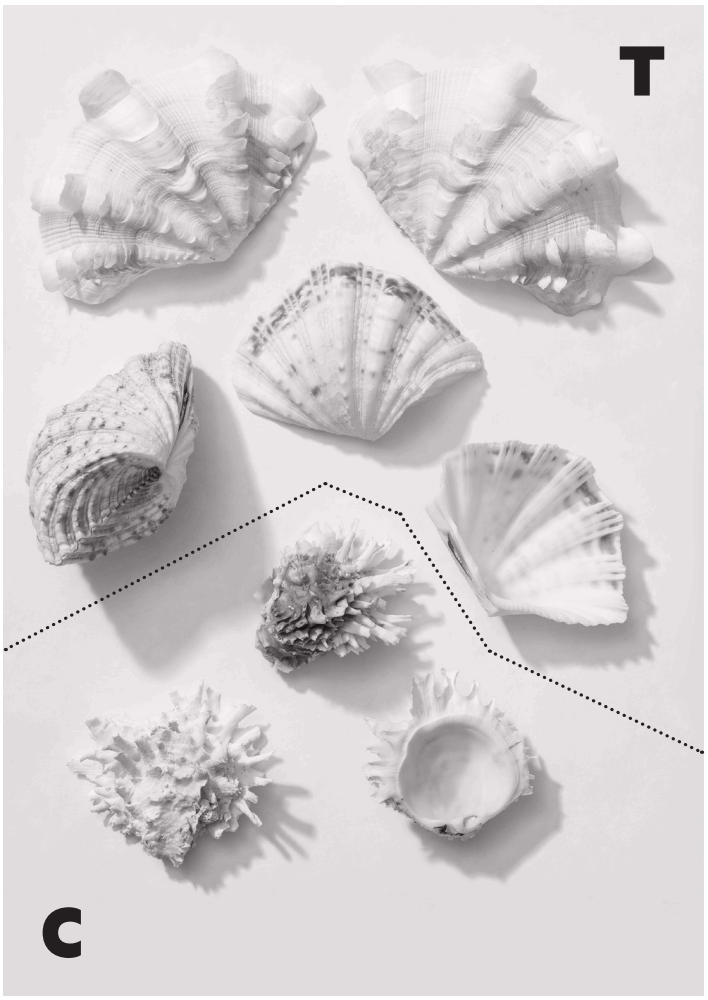
Mud whelks are common on mud flats in Queensland, as their name implies; at low tide they can seem to be everywhere you look. One common species (*Pyrazus ebeninus*) was eaten by Aboriginal Australians in Moreton Bay; shells of this species were also collected by Captain Cook and taken back to Europe. These molluscs feed on detritus and algae, and leave trails across the mud as they graze. Some mud whelk species are also hosts of parasitic worms that live in sea birds.

N – Nassariidae
C – Columbellidae

Nassariidae (Dog Whelks) & Columbellidae (Dove Snails)

Dog whelks live in intertidal and subtidal zones around the world, with the greatest diversity of species occurring in tropical regions. These molluscs feed on carrion (dead animals), and have a long proboscis that helps them find food in crevices. The name “dog whelk” may be related to the tendency of these snails to “sniff out” food with their long proboscis. “Dog whelk” may also have originated as a pejorative name, as these snails were considered not as good to eat as other molluscs.

Dove snails are small molluscs found in a variety of habitats, including rocky areas and seagrass beds. Some species of dove snails are carnivorous, feeding on crustaceans and worms, while others are herbivores and feed on algae. The name “dove snail” comes from the spots and colouration of some species, which resemble doves in appearance.



T – Tridacnidae
C – Chamidae

Tridacnidae (Giant Clams) & Chamidae (Jewel Box Clams)

Giant clams are iconic molluscs, famous for their large size and beauty; they can reach more than 1 m in length and weigh over 200 kg! These giant bivalves are filter feeders, but also acquire nutrients from microscopic organisms (zooxanthellae) living inside their tissues. Because zooxanthellae need light to survive, giant clams can only live in clear, shallow water. In some places there is a myth that giant clams can close their shells on, and trap, divers or swimmers. This would not be possible – giant clams do not "snap" their valves shut that quickly! In fact, humans pose more of threat to giant clams, as two species are at high risk of extinction in the wild due to the overharvesting of clam meat.

Jewel box clams are suspension feeders that live from the intertidal zone down to about 200m. The shells of some species are covered in multiple jagged layers that give them an ornate appearance, as can be seen on the plate. These clams are not considered to be edible in Queensland, although they have been consumed in other parts of the world. Jewel box clams are named because one valve is deeper than the other; the deeper valve and the flatter, lid-like valve together resemble a decorative jewel box.