CORAL

POLYPS, COLONIES AND REEFS

Coral polyps are tiny, soft-bodied organisms that secrete a calcium carbonate skeleton, and are related to sea anemones and jellyfish.

At their base, there is a hard protective limestone skeleton called a calicle which forms the structure of coral reefs. Reefs begin when a polyp attaches to a rock face and multiplies (buds) into hundred to thousands of clones. The polyp calicles connect to one another to form colonies that join to build a reef structure. They live and function as one organism although, one polyp can live on its own.

Some modern-day reefs have been growing for the past 50 Ma.

Common name	Coral
Phylum	Cnidaria
Class	Anthozoa
Size relative to a tea cup	
Diet	Carnivores
Type	Invertebrates

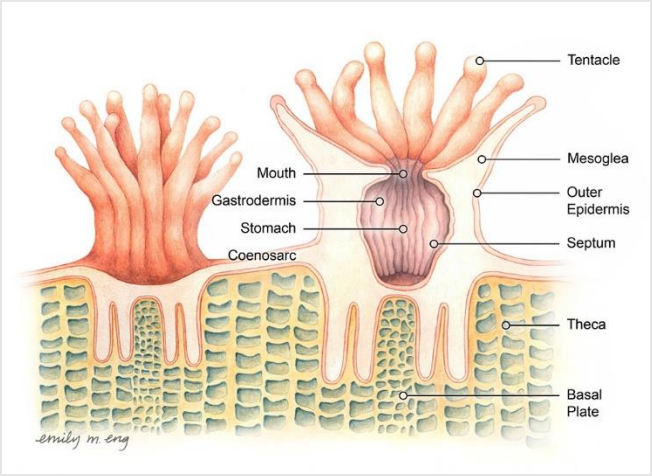
Corals belong to the phylum Cnidaria (which includes sea anemones and jellyfish). They are simple marine organisms but their bodies consist of two layers; an **outer ectoderm** and an **inner ectoderm, stinging cells** called **nematoblasts.**

Note: all **Cnidarians** have tentacles with **stinging cells called nematoblasts** which are uses to **capture and sedue** their prey. The phylum Cnidarian literally means "**s**tinging creature".

Corals themselves (and sea anemones, stony corals, soft corals etc.) belong to the class **Anthozoa** which all build calcareous skeletons. Early corals evolved in the Cambrian and modern ones still live today.

For a modern-day coral polyp, the **corallum** is the whole skeleton of a **solitary** (living as a single polyp so has only one corallite) or **colonial coral (**many polyps living as a colony so many **corallites** adjoined).

- **Solitary corals** have only one polyp secreting a single skeleton (**corallite**)
- **Colonial corals** have many polyps living together in a communal fashion, with many skeletons or **corallites** fused together. Colonial forms have skeletons which may also **branch**.



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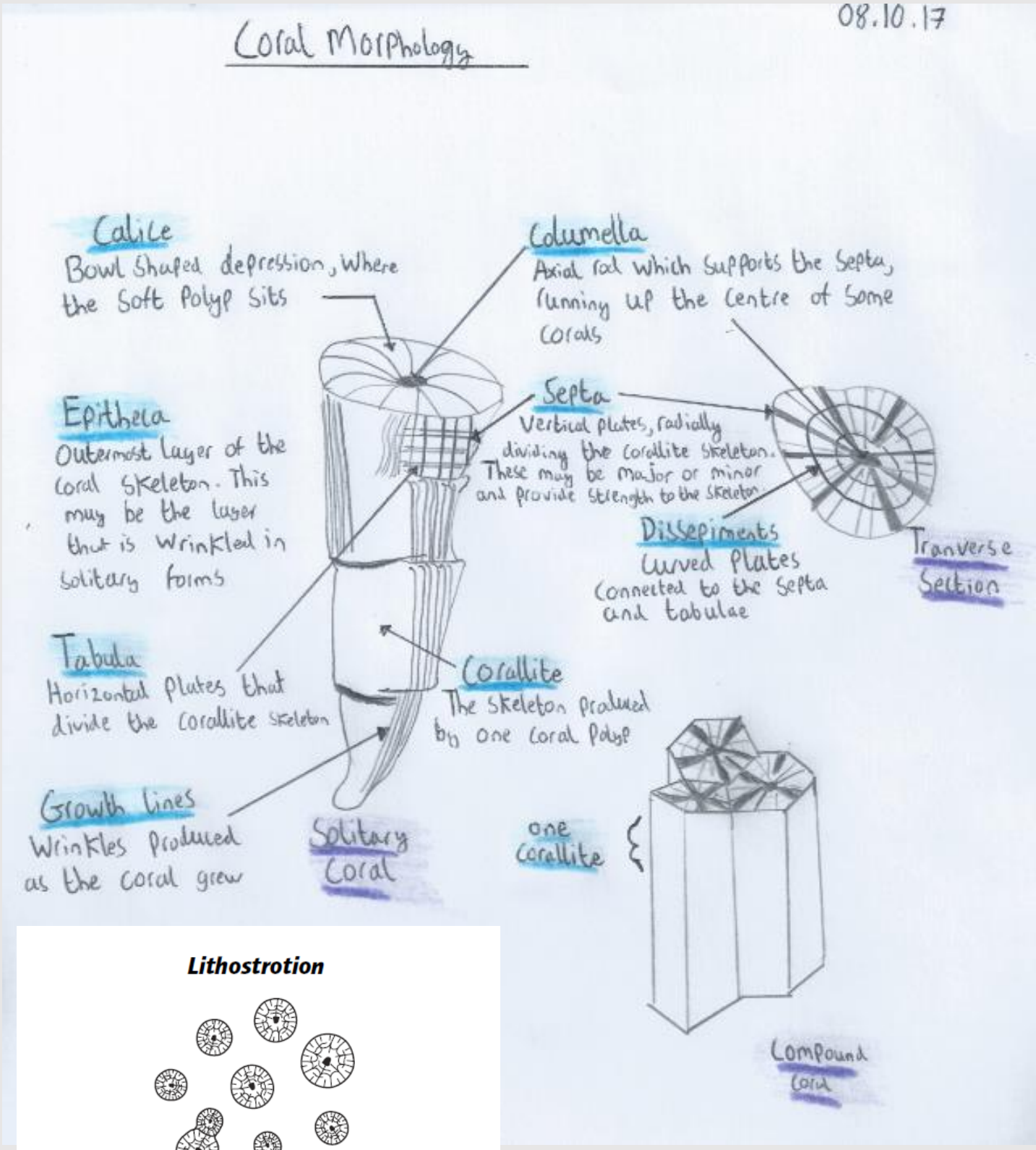
Coral Morphology



Lithostrotion

Rugose coral
Carboniferous

The corallites are typically less than 1 cm in diameter. A small, central, bar-like columella is developed and there is a pronounced edge zone composed of dissepiments. Overall, colonies can exceed 1 m across.

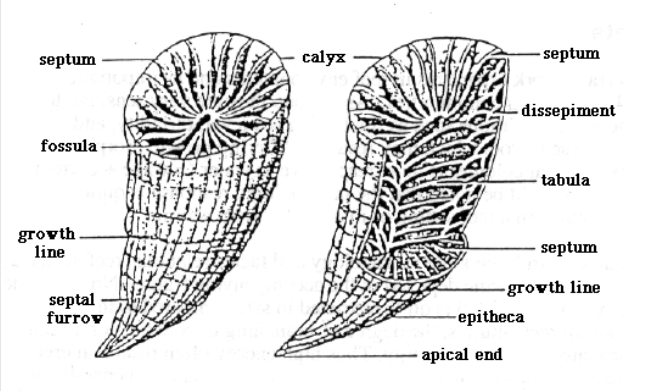
This coral genus shows a great deal of environmentally determined variation. Corallites within the colony may be separated from one another, a form known as fasciculate. However, they may also be in close contact with one another, with the shape of the corallites modified accordingly.

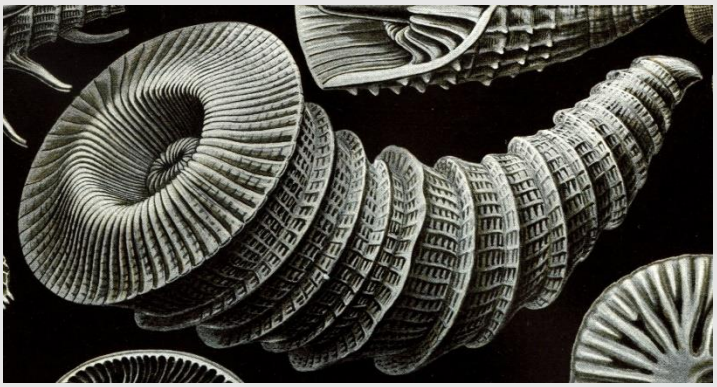
RUGOSE, TABULATE AND SCLERACTINIAN CORALS – WHAT IS THE DIFFERENCE?

These are the three main orders that are important in the fossil record.

Rugose corals

- These extinct corals lived either **colonially or solitarily**. **The epitheca** is often wrinkled and they may be **'horn-shaped'** in solitary forms.
- They usually form **large corallites** with **no mural pores or connections** between other corallites.
- They show **bilateral symmetry** running along their vertical axis.
  This bilateral symmetry is owed to the **distinct septa**, the plates **running vertically** within the skeleton. The coral has **major septa at 6 points** with **4 sets of minor septa**. This is because corals initially had 6 septa as they began growing and new septa were only added in four of the resulting spaces.
- They always have **columella** and **may have dissepiments between** the **septa**, but these were not always present.
- The whole structure can be straight or curved (horn-shaped), the corallite is a conical shape.





Their internal structures are **dominated by septa**, vertical plates organized in a radial pattern. **Tabulae** and dissepiments are also common although dissepiments are not always present.

Solitary corals grew with a **horn shape** and for colonial corals (the corallum) typically formed a **dome shape**. Corallite shapes varied in a colony, often defined by their proximity to other corallites. Corallites in direct contact tended to become **polygonal** in shape but isolated corallites kept a **circular cross section**. Rugose corals did not form the framework of the reefs they inhabited due to their lack of holdfasts.

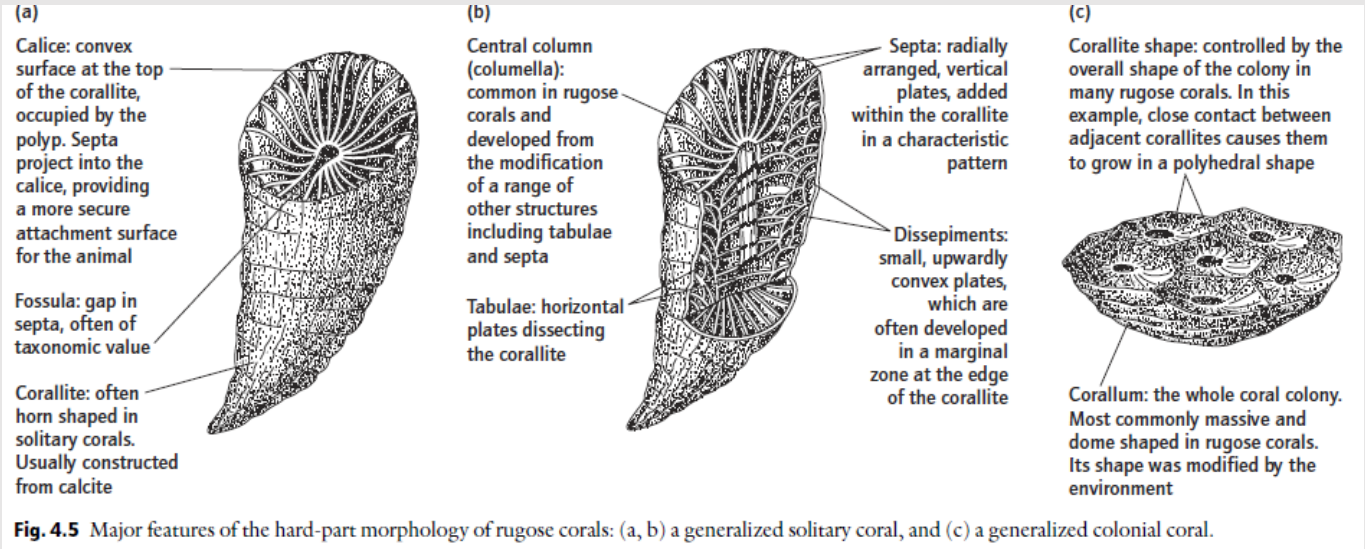
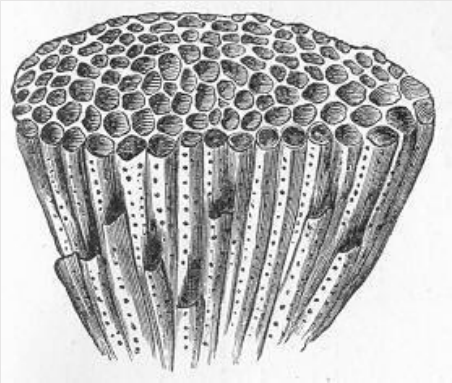
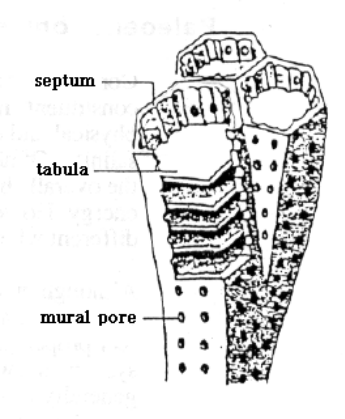


Fig. 4.5 Major features of the hard-part morphology of rugose corals: (a, b) a generalized solitary coral, and (c) a generalized colonial coral.

Tabulate corals

- These extinct corals are always **colonial** with **well-developed tabulae**.
- The **corallites are usually small** and **mural pores** are present in some species.
- They show **radial symmetry (symmetry about a central axis like a starfish)** but the development of **septa is either poor or absent**.
- They **may have dissepiments** but they were not always present and they **do not have a columella.**





Tabulae represent former levels of the calice floor, secreted by the polyp to seal off the lower area of the corallum (entire skeleton of a compound coral).

Tabulate corals were **always colonial**, and the individual polyps tended to be small.
The most diagnostic elements of the tabulate corals are the structures developed within the corallite; horizontal **tabulae and dissepiments** are **well developed**. The corallites which had outer walls (**Epitheca**), were usually **perforated by mural pores.** This allowed for **direct conne**ctions between the soft tissues of adjacent polyps.

In colonies, the new corallites either grew on the outer edges (peripheral growth, occurring in deep water) or they grew in between existing corallites (medial growth, corals on a reef margin). Corals in the core of a reef in shallow waters showed both growth techniques.

Halysites

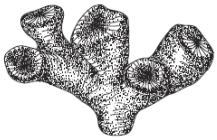
Tabulate coral
Middle Ordovician–Silurian
A colonial coral with a distinctive chain-shaped corallum. This cateniform shape is rare. Each corallite is connected to the next by a coenenchyme composed of a single tube cut horizontally by many small plates. Corallites are usually 2–6 mm across.

The chain form of this coral had several advantages, especially in areas of high sedimentation rate. The holes between the polyps allowed them space to spread out for feeding, and also to dispose of unwanted sediment. They were able to colonize large areas of the sea bed very rapidly early in their development, and then to grow upwards to keep up with sediment influx.

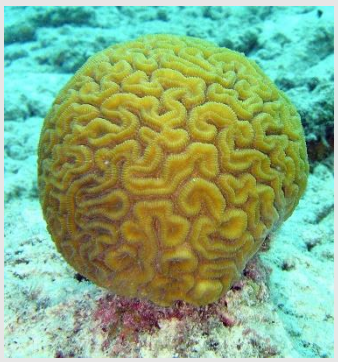
Scleractinian corals

- These still form reefs today. They are either solitary or colonial and the corallites are usually small **with no mural pores** between colonial forms.
- They show **radial symmetry** known as **hexagonal symmetry**. This symmetry is owed to the **distinct septa** in the skeleton, with **six primary septa** and **evenly developed secondary septa** between them.
- They **always have dissepiments** and **always have tabulae.**

Thecosmilia



Scleractinian coral
Middle Jurassic–Cretaceous
A colonial form characteristically composed of a few large corallites, perhaps 10 in a colony, each with a diameter of 2–3 cm. The corallite form is similar to that of *Montlivaltia* (right). The corallum shape is fasciculate, and the corallites usually branch one from another.



The corallite of a Scleractinian coral is **dominated by septa**. **Dissepiments and a columella** also developed. Colonial scleractinian corals have **well integrated soft tissues** and often **lack corallite walls**. Reefs commonly develop as fringes around islands and grow in rate with rising sea levels, growing upward and outward against high energy waves. They are the most important reef builders of the **Mesozoic and Cenozoic**.

SUMMARY

Property	Type of coral		
	Rugose	**Tabulate**	**Scleractinian**
Geological range	Ordovician to Permian (**extinct**)	Cambrian to Permian (**extinct**)	Triassic to Recent (**extant** = still in existence)
Tabulate	Always present	Present and well-developed	Always present
Corallites	Large	Many small	Many small
Dissepiments	Sometimes present	None or sometimes reduced	Always present
Symmetry	Bilateral	Radial	Radial
Columella	Always present	Not present	Maybe present
Septa	Major septa at 6 points, with 4 sets of minor septa	Sometimes present but poor or reduced	Major septa at 6 points radially
Mural pores	None	Mural pores may be present	No mural pores
Colonial/Solitary	Either	Always colonial	Either
Example	Lithostrotian sp.	Halysites sp.	Thecoskilia sp.

Sp. = species pluralis (clonial)

Key terms

- **Mural pores**: connections between adjacent corallites, perhaps for communication.
- **Bilateral symmetry:** is where many planes of symmetry can be seen.
- **Extant**: describes a species that is still alive today.

CORAL SOFT PARTS

Corals often have **bilateral symmetry** (a plane that splits a body into two mirror images, right and left). Coral polyps are sack shaped with their **widest part at the top** (the mouth) narrowing to a base where it was attached.

The soft parts (polyps) are similar in all subclasses of **Anthozoa**. The body cavity is divided into small segments by **septa** (partitions) which give it **stability and strength** and provide **more efficient feeding**.

- Outer Layer = **Ectoderm**
- Inner layer = **Endoderm**
- Inner body cavity = **Enteron**

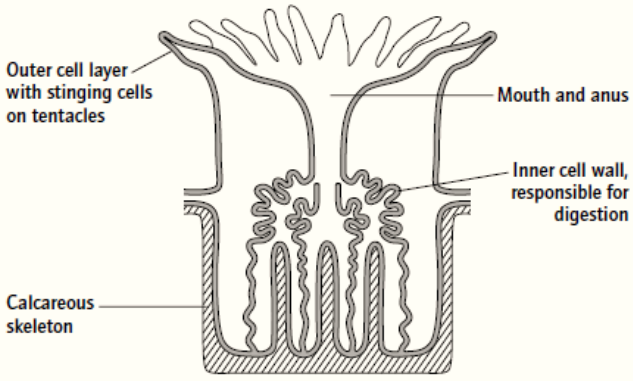


Fig. 4.3 Section through a generalized coral polyp to show the soft-part morphology. Medusoid stages are similar in morphology, but live "upside down" relative to this diagram, with the mouth hanging below a soft bell of tissue, and no skeleton.

PALAEOENVIRONMENT

Coral were **sessile (fixed to a surface so immobile).** They were **benthonic** but lived in shallow seas **(<30m deep**). They require well-oxygenated water. The whole coral colony is called the **corallum**.

Cnidarians evolved in the Precambrian and are amongst the **earliest multicellular animals** to be found in the fossil record. Tabulate and Rugose corals evolved from soft-bodied anemone ancestors in **the Ordovician period.** They **thrived in the Silurian, Devonian,** and, following a late Devonian decline, in the **Carboniferous**. They gradually **declined and disappeared in the Permian-extinction**. They were part of the Paleozoic reef community but lacked the holdfast needed to clamp onto surfaces and build up the framework of a reef structure unlike modern **Scleractinian corals.** **Scleractinian corals** evolved in the **Triassic** and radiated **throughout the Mesozoic** . Although, many genera became extinct during the end-Cretaceous extinction, they have come to dominate **modern Cenozoic reefs**.