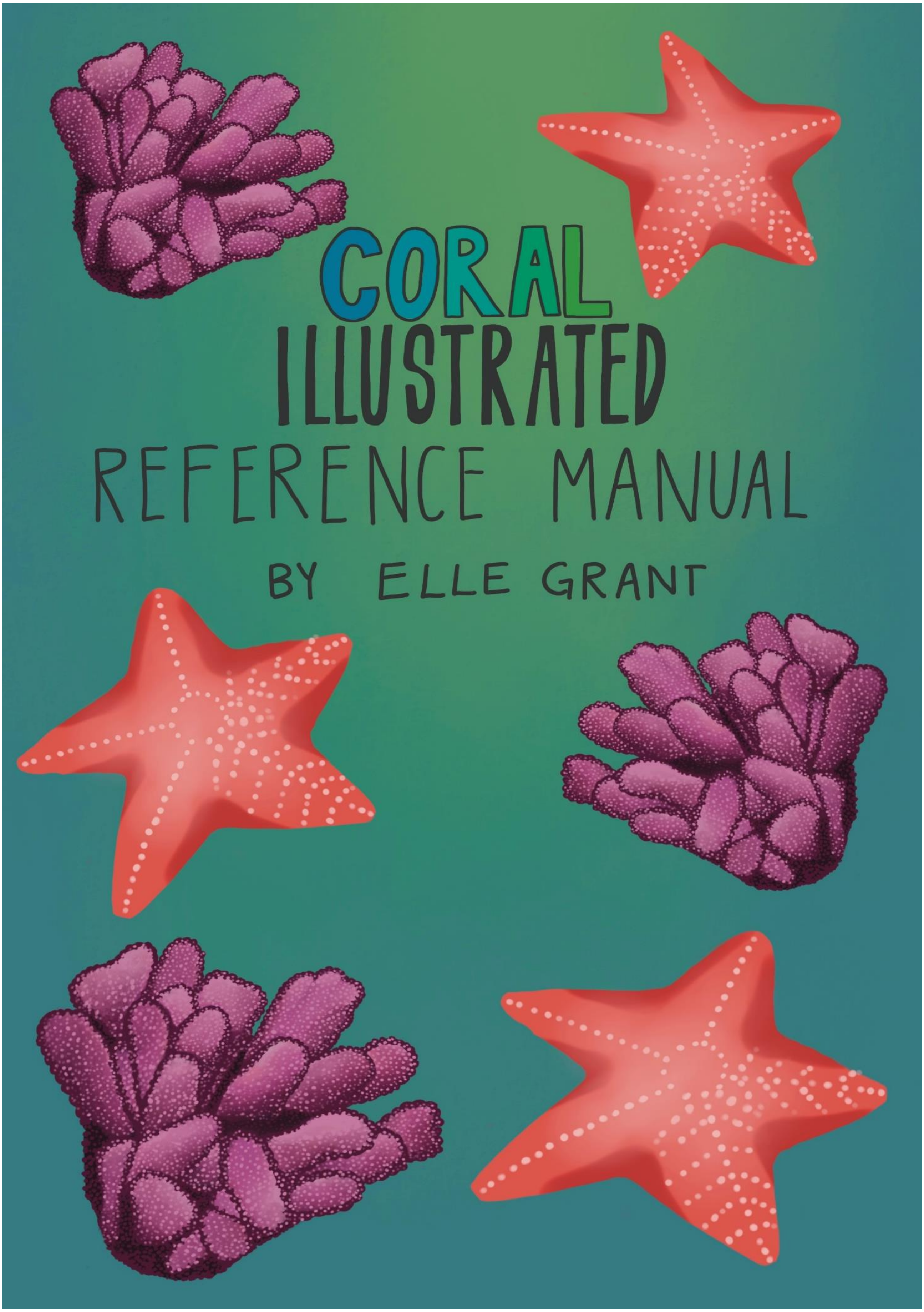
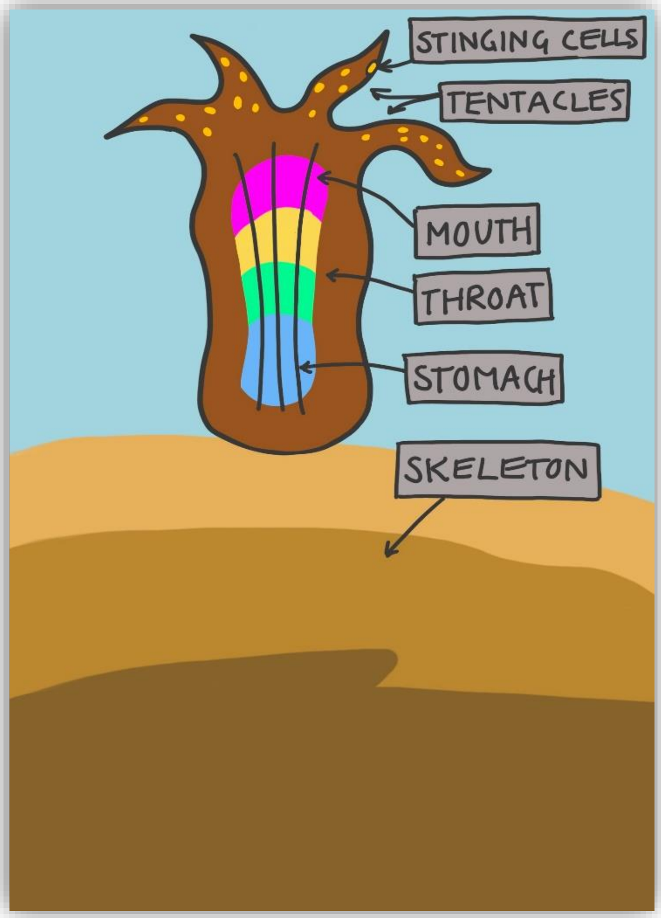
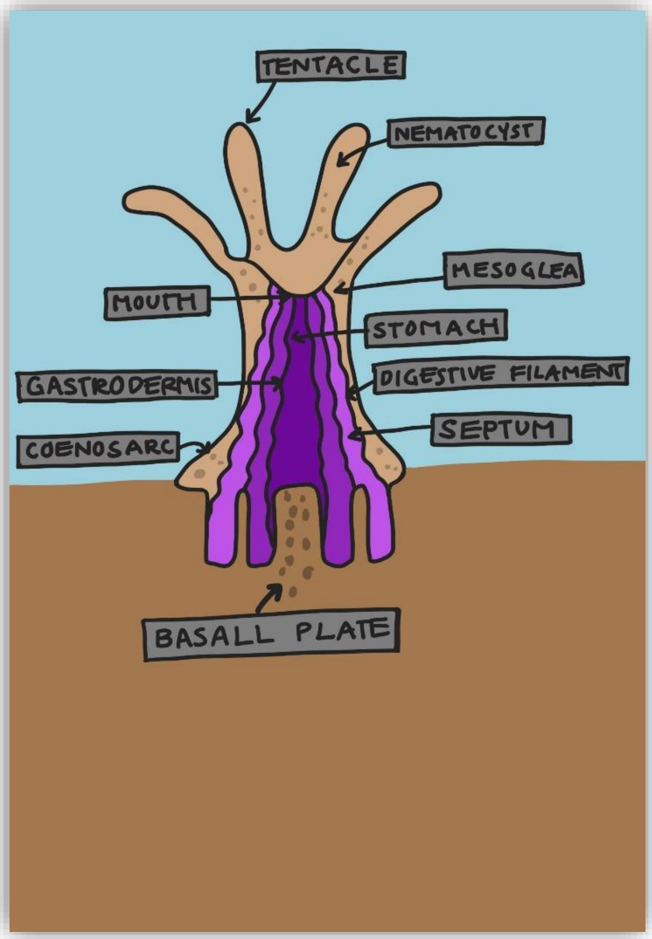

CORAL
ILLUSTRATED
REFERENCE MANUAL
BY ELLE GRANT

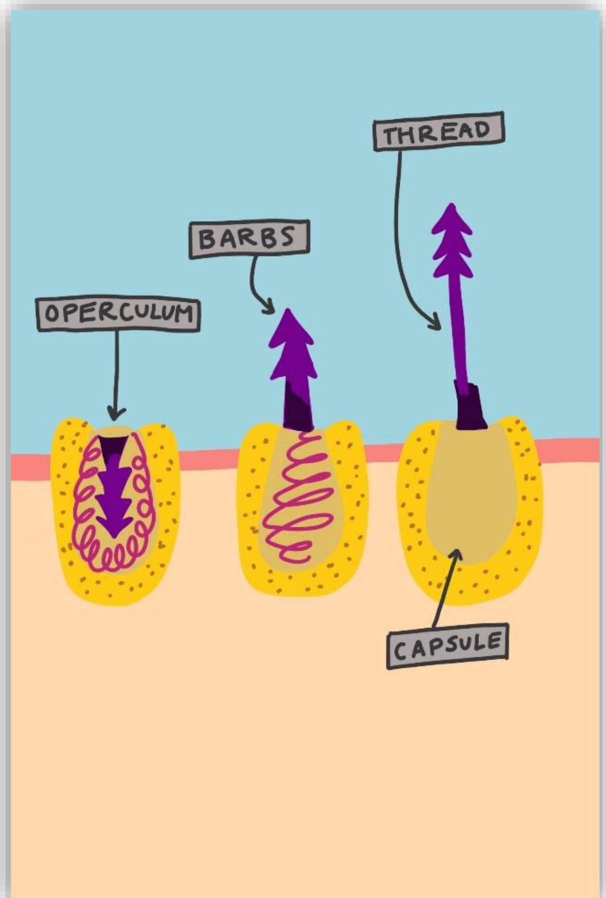
Corals are invertebrate animals and belong to the animal named Cnidaria. Composed of hundreds to thousands of individual animals called polyps. Each polyp has a **stomach**, a **mouth** surrounded by **tentacles** that is used as a defense mechanism, to capture food, and to clear debris.

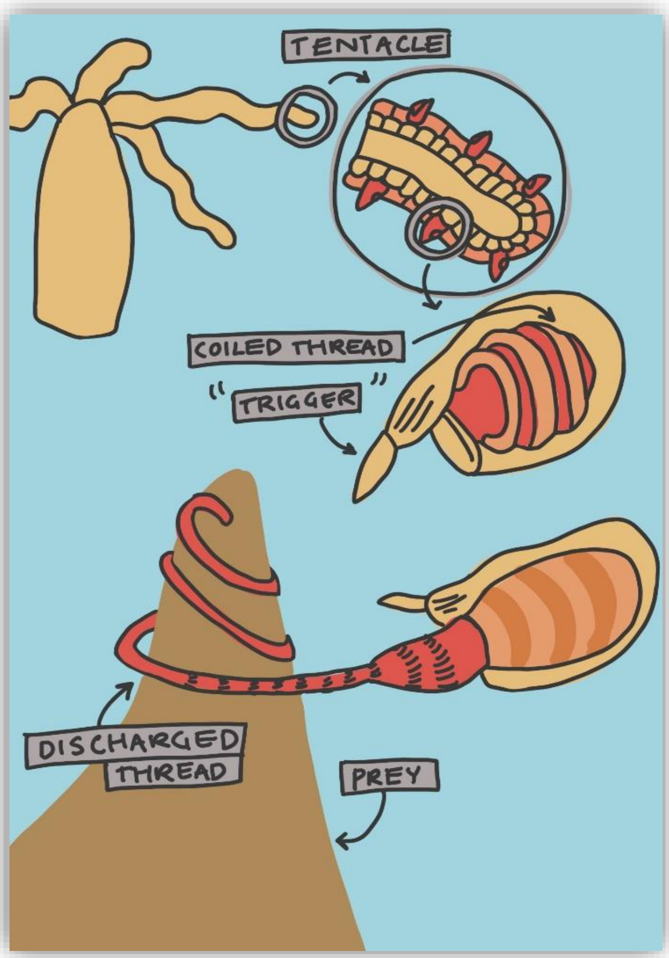




Internally, corals possess a central **gastrovascular cavity** which serves as both their digestive system and a means for nutrient distribution. This cavity is lined by two main layers: the outer epidermis and the inner gastrodermis, with the mesoglea in between.

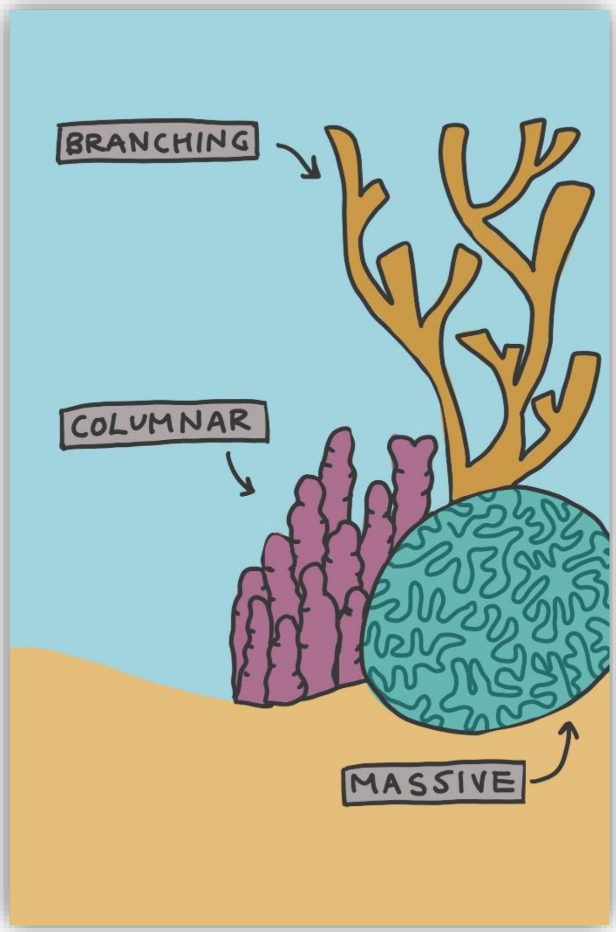
Coral are mostly night feeders. To capture food the coral uses stinging cells, or **nematocysts** to immobilize prey which is then brought to the coral's central mouth for digestion. Located in the tentacle and on the outer tissue of the coral.

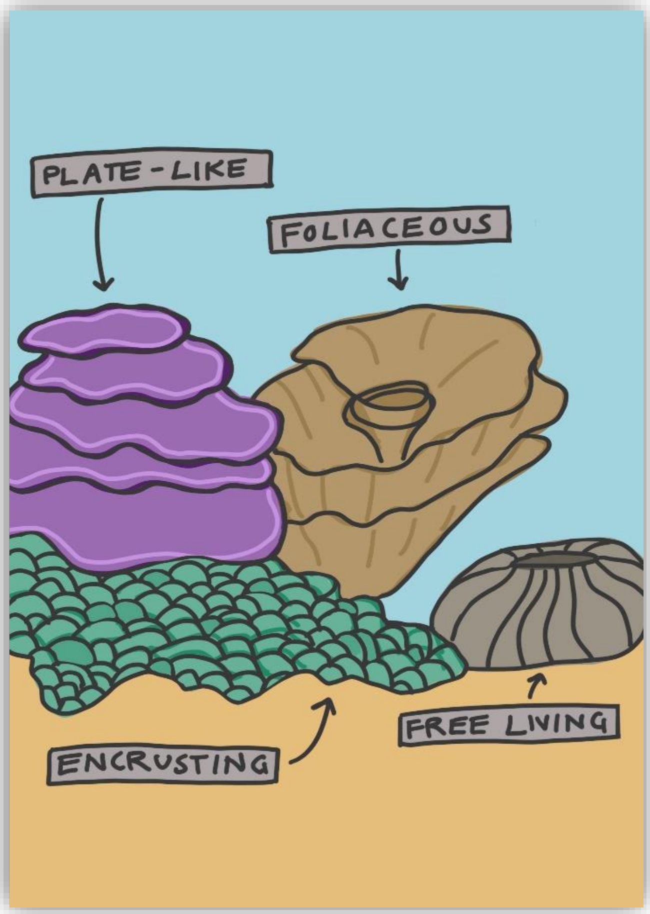




Nematocysts are stinging cells found in corals that contain a coiled, thread-like structure capable of ejecting toxins to capture and immobilize prey. When triggered by contact, the nematocyst fires, injecting venom into the prey, which helps the coral subdue and ingest it. This mechanism is crucial for both feeding and defense, and cnidocytes are continuously regenerated to maintain their effectiveness.

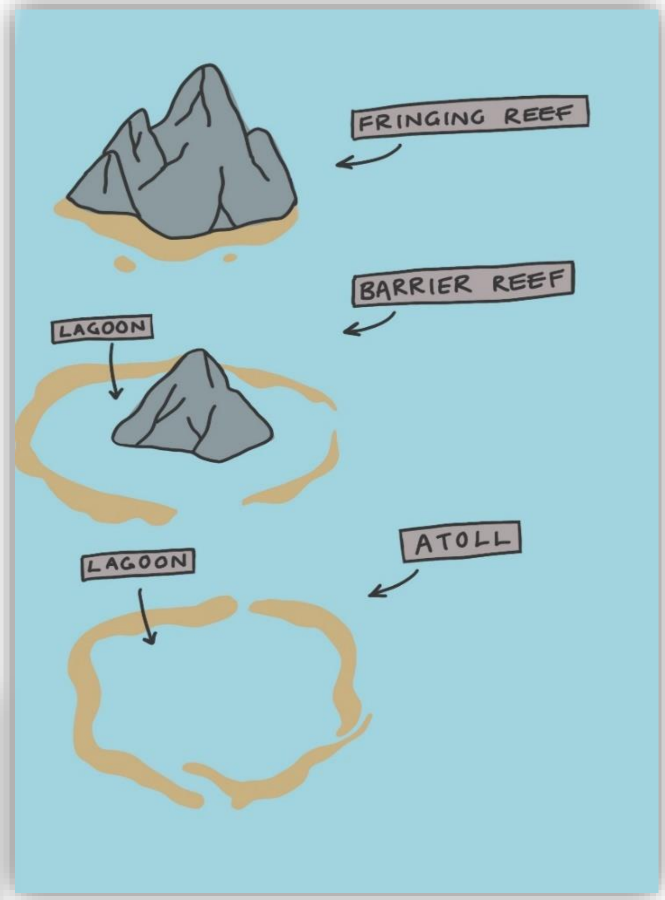
Coral takes shape in many different forms. “Large reef building colonies, graceful flowing fans, and even small solitary organisms.” (Noaa, 2019) Corals adopt various structures to adapt to their specific environments and ecological niches. Differences in structure, such as **branching**, **massive**, or **plate-like** forms, are influenced by factors like water flow, light availability, and competition for space.

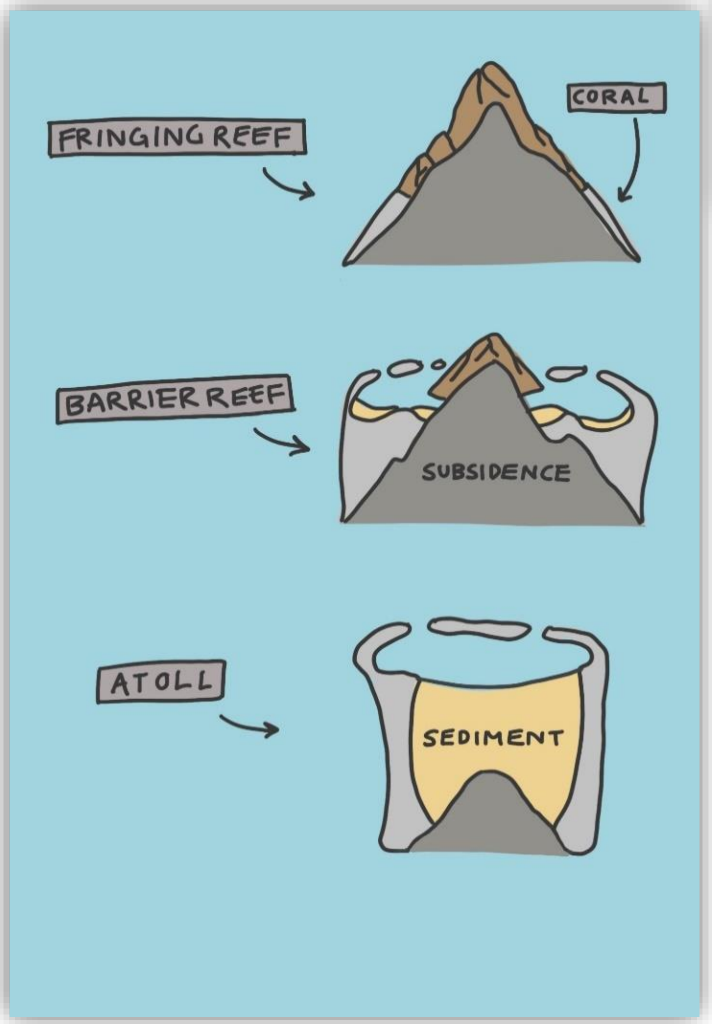




These structural adaptations help corals optimize their access to resources, protect themselves from environmental stresses, and enhance their ability to capture prey and interact with other marine organisms.

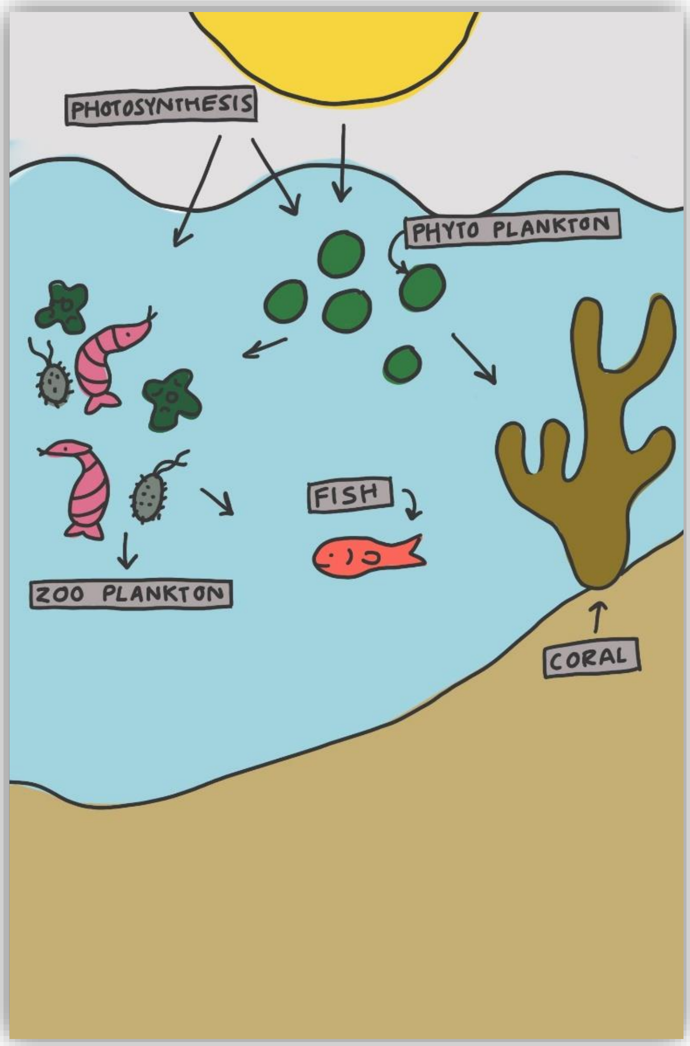
“**Fringing reefs** are reefs that are close to or are connected to shore. **Barrier Reefs** are offshore reefs that are separated from the land by an expanse of water, such as a lagoon. **Atolls** are circular or oval reefs surrounding a lagoon, without any central land mass in the lagoon.” Webb (2023)

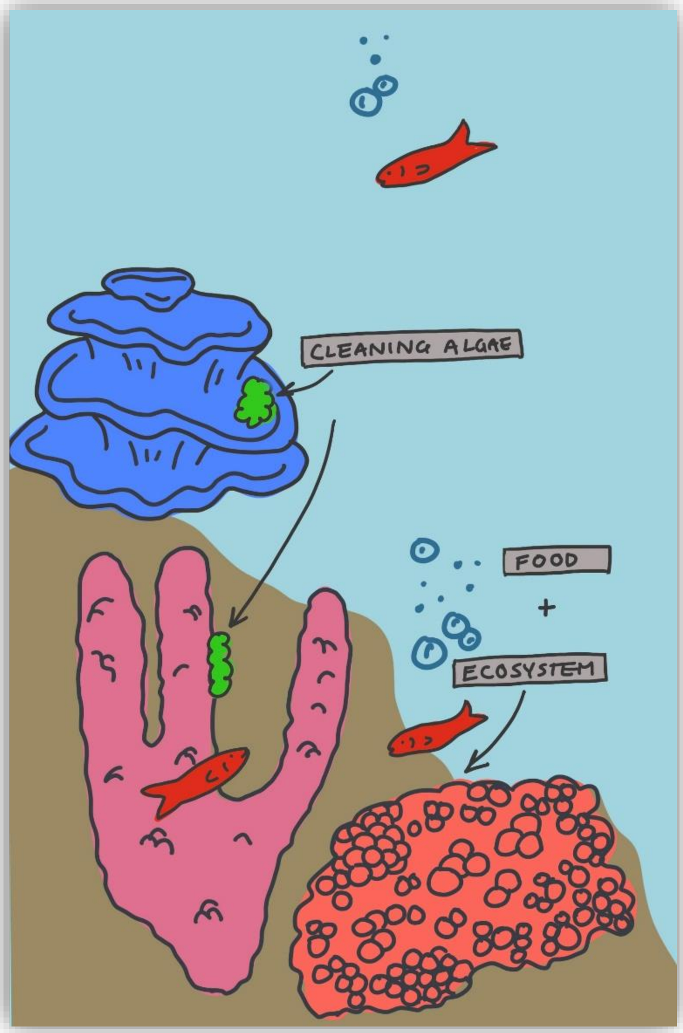




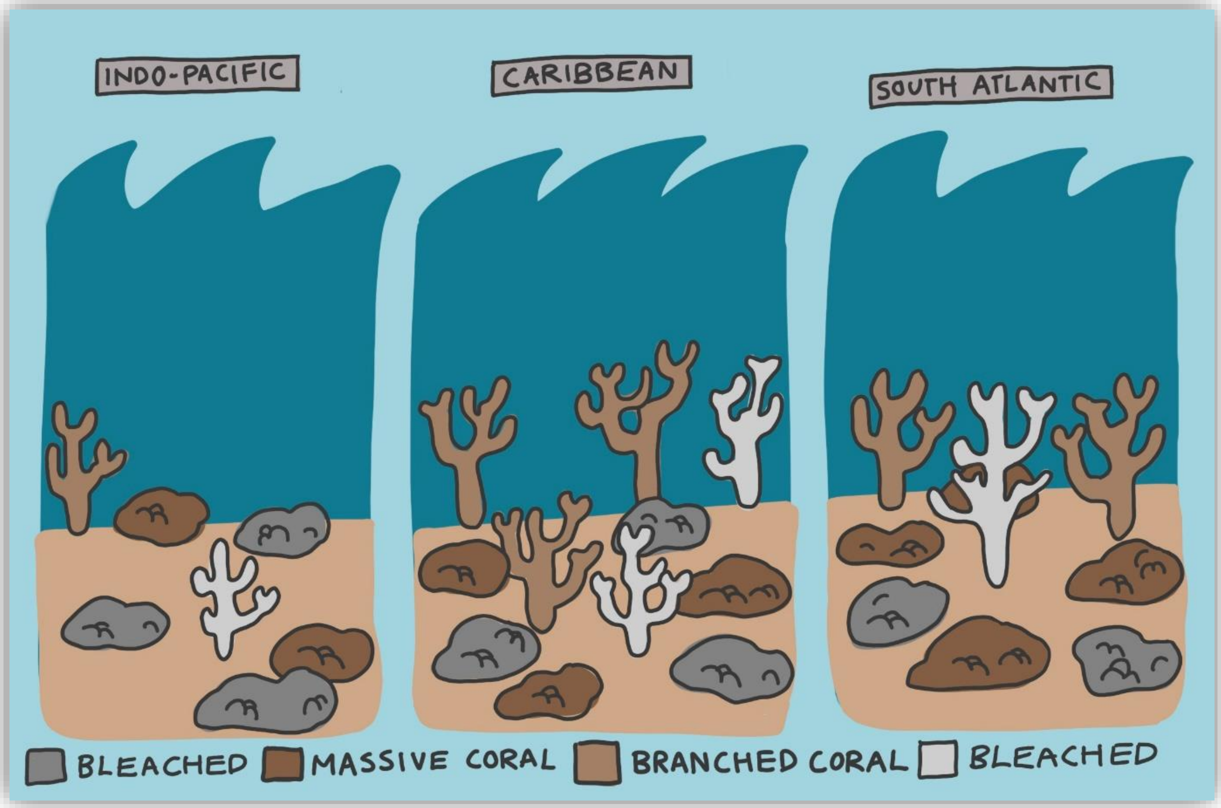
As seen from the side perspective, what starts as a **volcanic mountain** eventually becomes a fringing reef until it becomes an atoll which is a fully subsided volcano leaving behind only the corals structure.

Coral serves many purposes, but is one of the most significant ecosystems in the world, because of this, corals have been named the **“Rainforest of The Sea”**



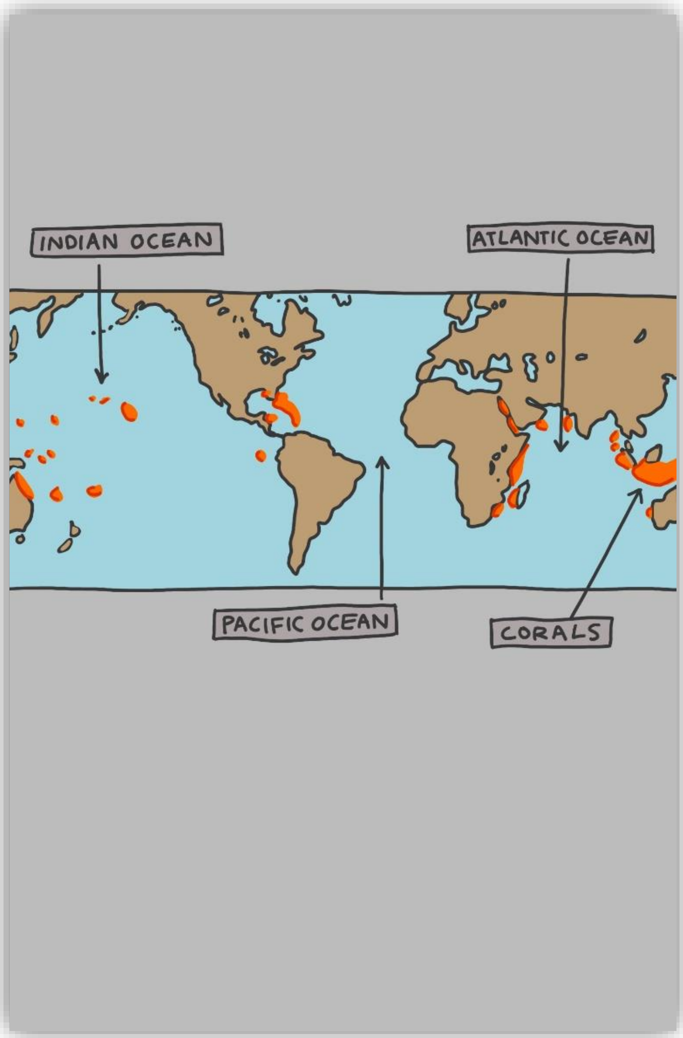


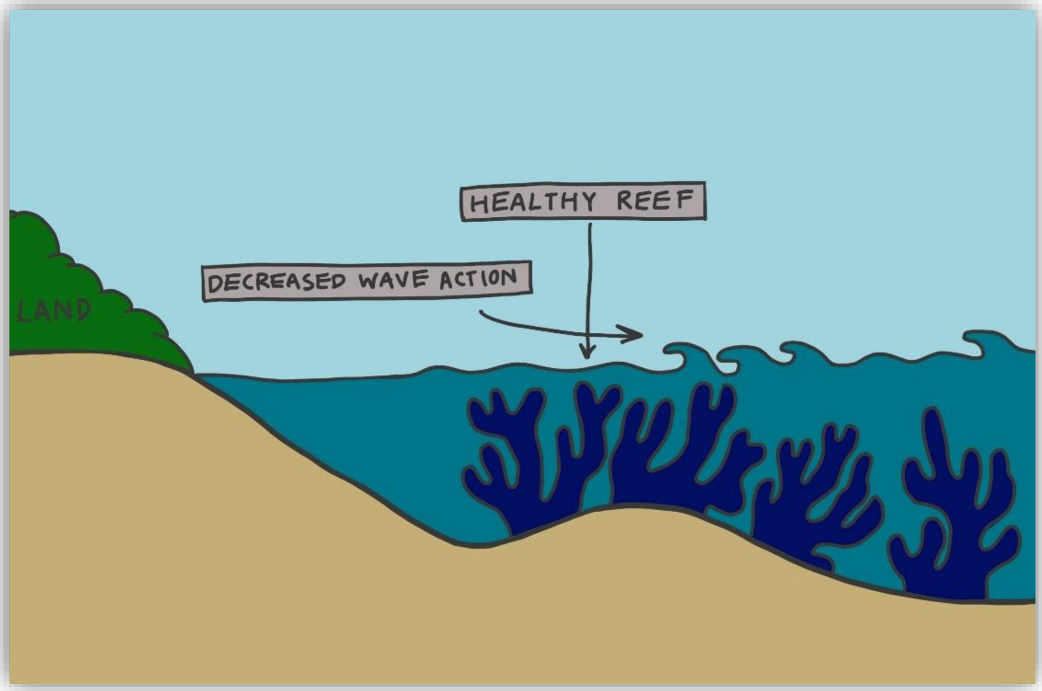
Just as rainforests support a vast array of plant and animal species, coral reefs provide habitat and sustenance for a wide variety of marine life, from **colorful fish** and **invertebrates** to **algae** and **microorganisms**. Their vibrant structures and diverse inhabitants create a underwater ecosystem that is crucial for maintaining the health of the ocean.



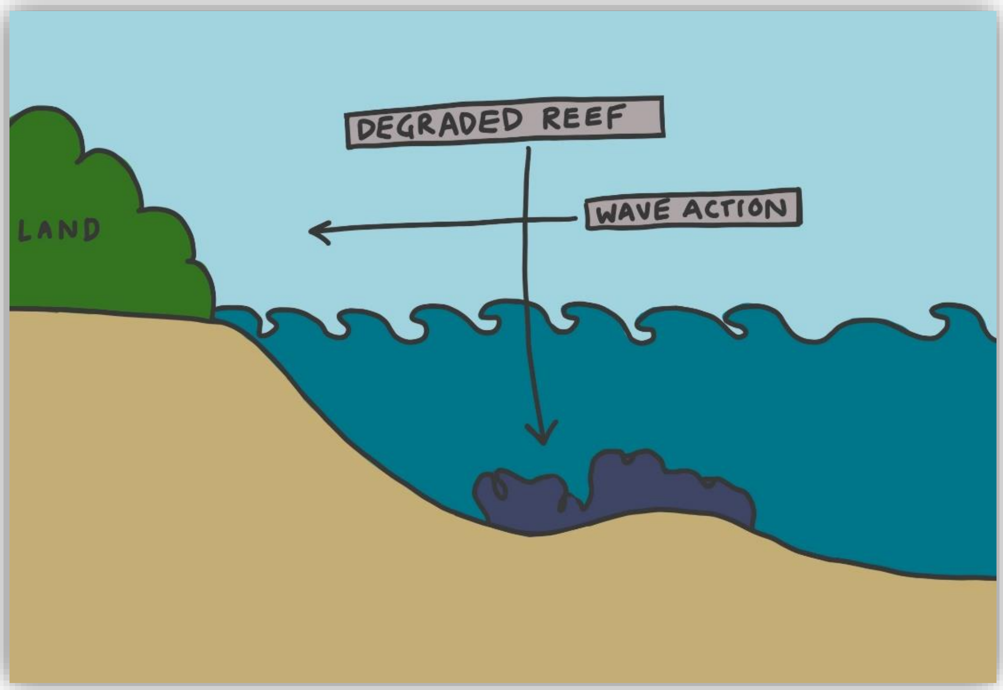
Corals are found in a variety of environments, from **warm**, **shallow**, **tropical** waters to the **cold depths** of the ocean. Different species of corals are adapted to these diverse conditions, resulting in a variety of coral formations across the world's oceans. This diversity is reflected in the distinct types of corals observed in different marine environments.

In this photo, the areas highlighted in orange represent the regions with the **highest abundance of corals**, spanning from the Indian Ocean to the Atlantic Ocean.

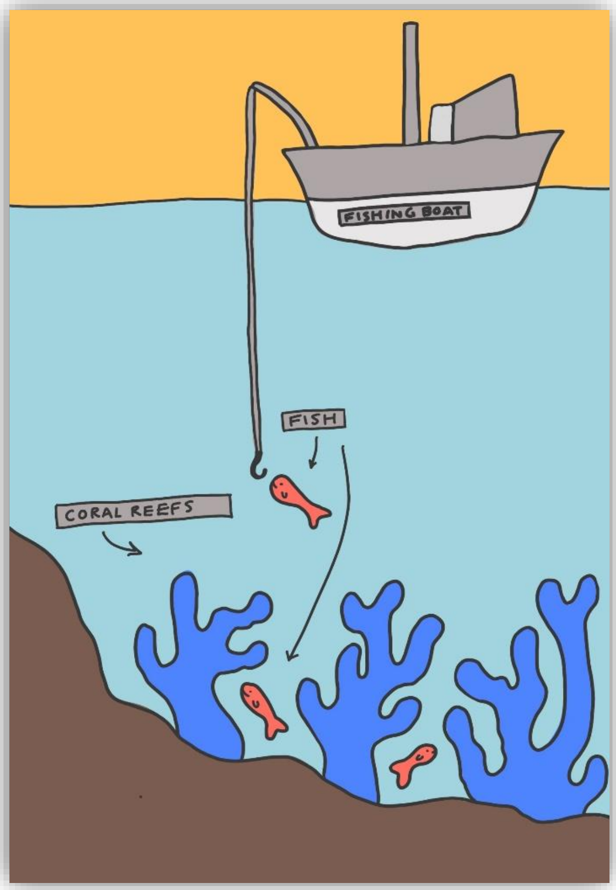




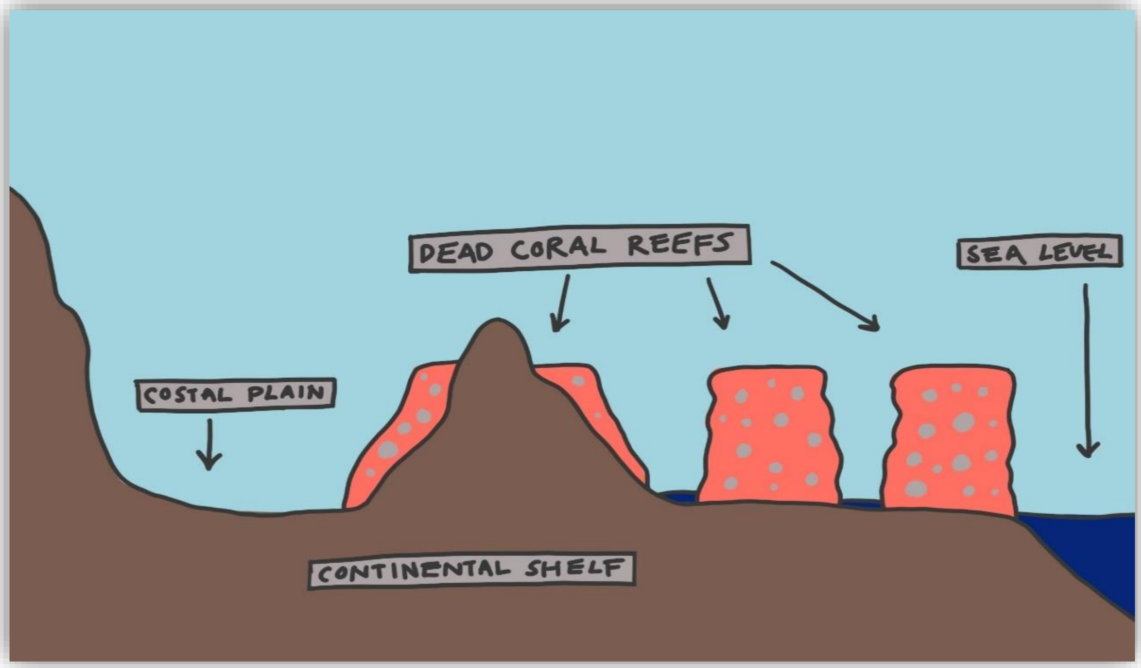
Corals have provided **coastal protection** for generations, protecting both people and property. Corals protect land in various ways, one of which is demonstrated in this diagram: coral reefs help **reduce wave action**, thereby preventing coastal erosion and damage



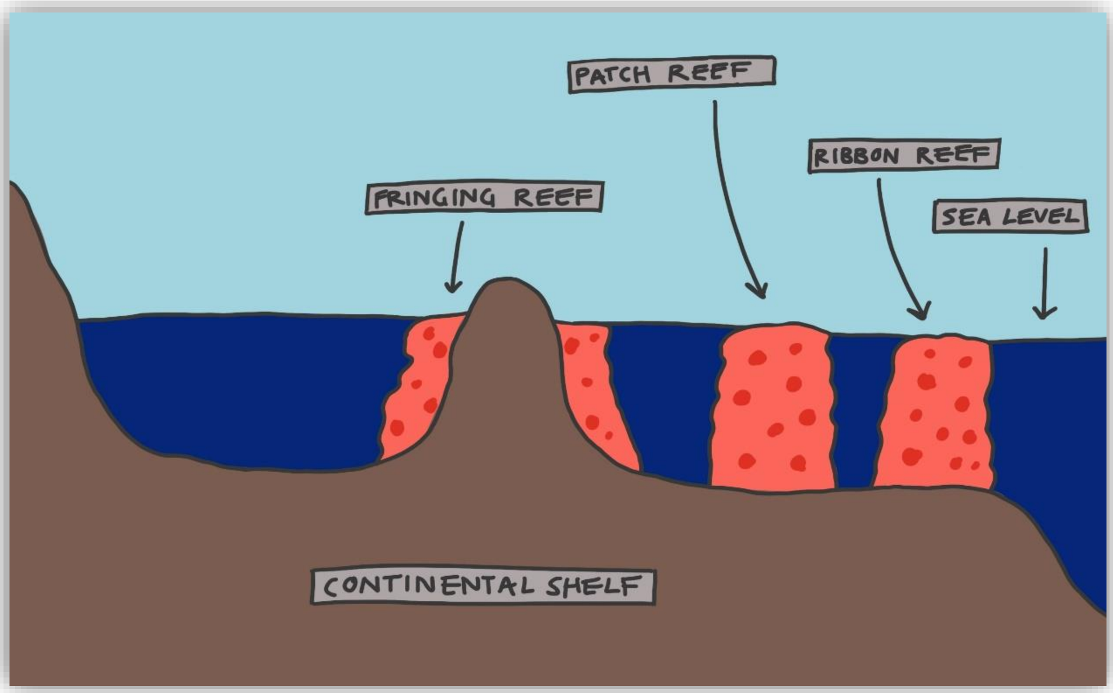
Coral degradation significantly impacts over half a billion people who rely on reefs for their **food**, **income**, and **coastal protection**. Coral reefs are vital ecosystems that support a wide range of marine life, including numerous fish species essential to local fisheries



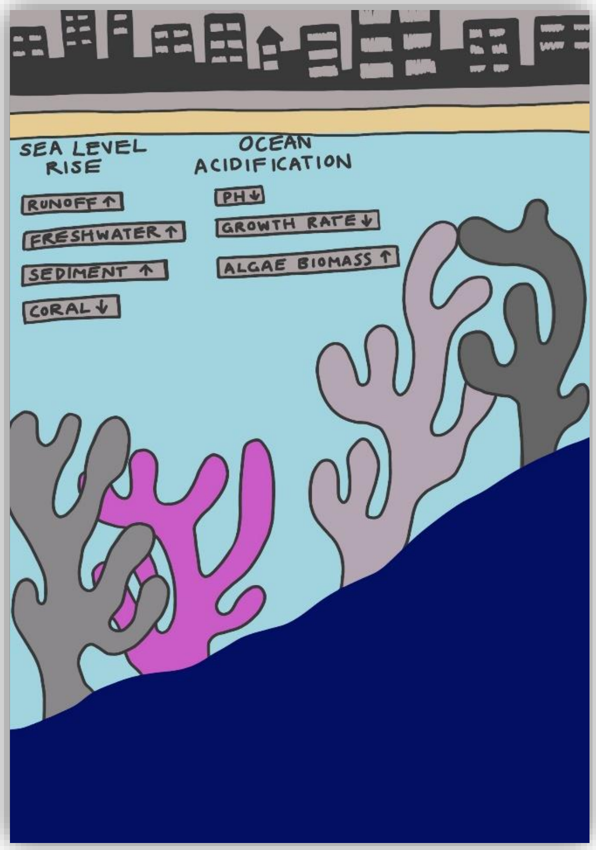
As reefs deteriorate, fish populations are disrupted, which adversely affects the **fishing industry** that depends on these species for both sustenance and economic stability. The decline in coral health thus has far-reaching consequences for both the ecological balance and the livelihoods of those who depend on these vital marine resources.

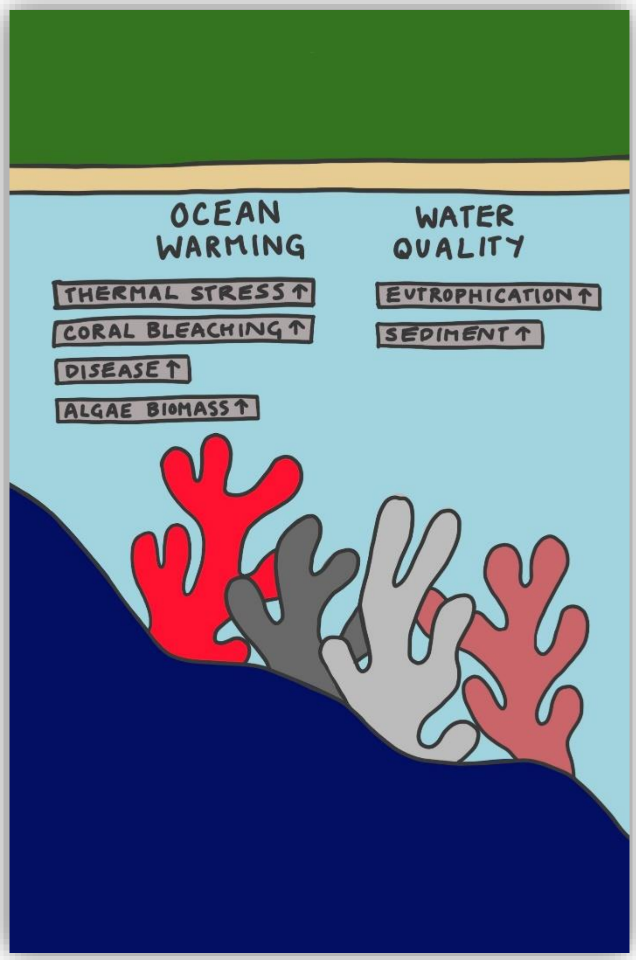


Human impacts on coral can range from increasing **ocean warming**, **acidification**, **deoxygenation**, and more. "For coral, migration to move to a more favorable environmental conditions is only possible at the larval stage." (Burdett, 2024) Threatening the survival of the corals in these conditions



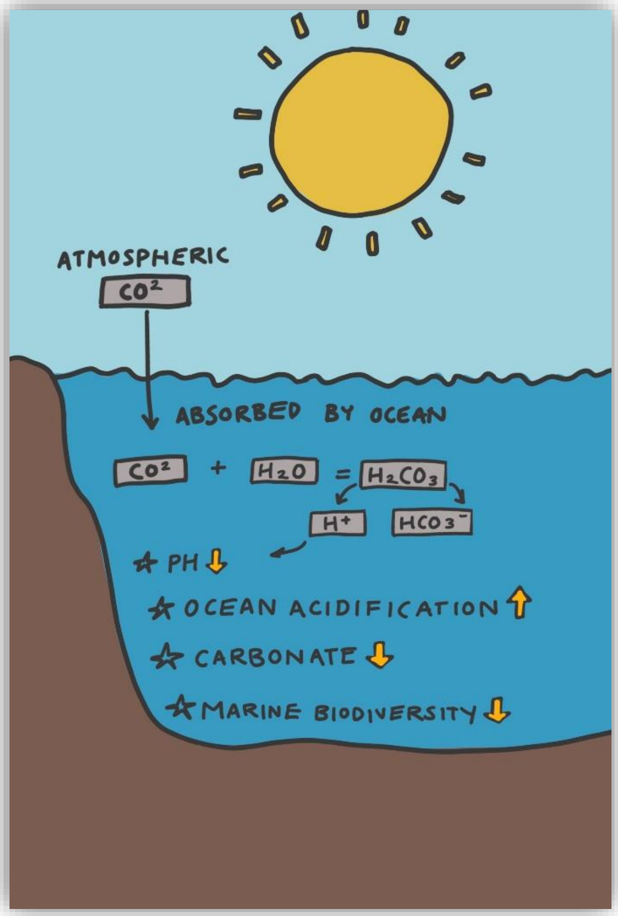
The impact on corals manifests in several ways. Rising sea temperatures can lead to **coral bleaching**, sea level rise can hinder **coral photosynthesis**, and ocean acidification can slow **coral growth** and weaken the structures of corals."

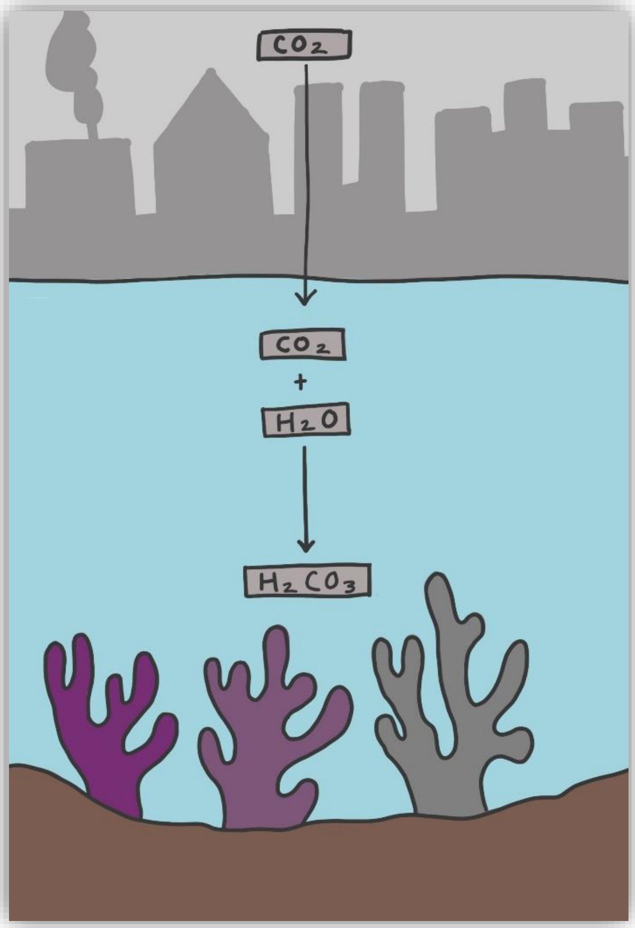




"Since the 1990's, rising sea surface temperatures have driven massive losses of coral cover with changes in community assembly and function that threaten these exceptionally high-value ecosystems" (Landry, 2023)

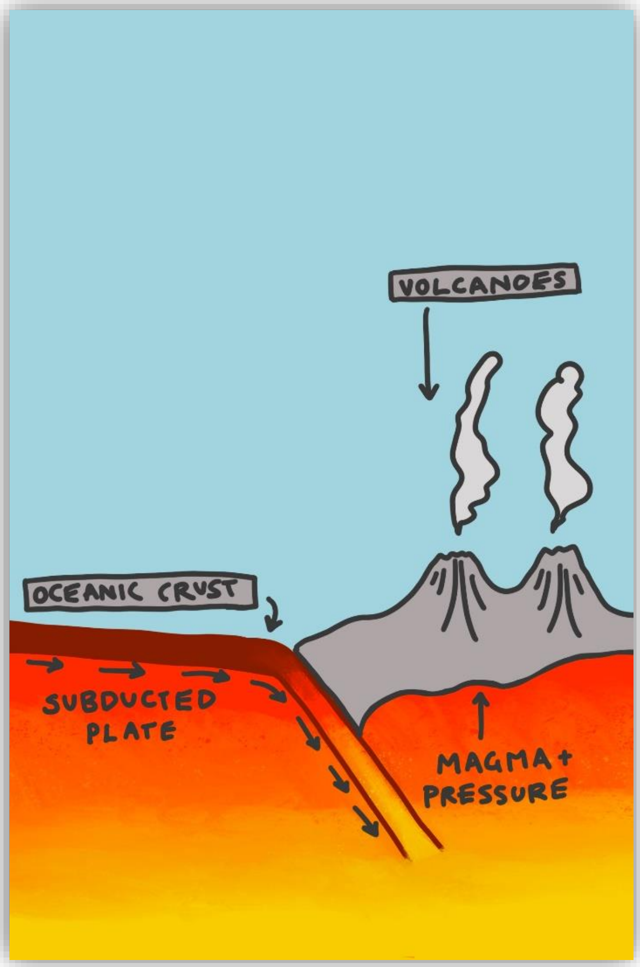
Emissions of greenhouse gases, such as **carbon dioxide** (CO_2), contribute to ocean acidification, temperature changes, and coral bleaching. When these gases are released into the atmosphere, they increase the concentration of CO_2 in the ocean as it dissolves in seawater.

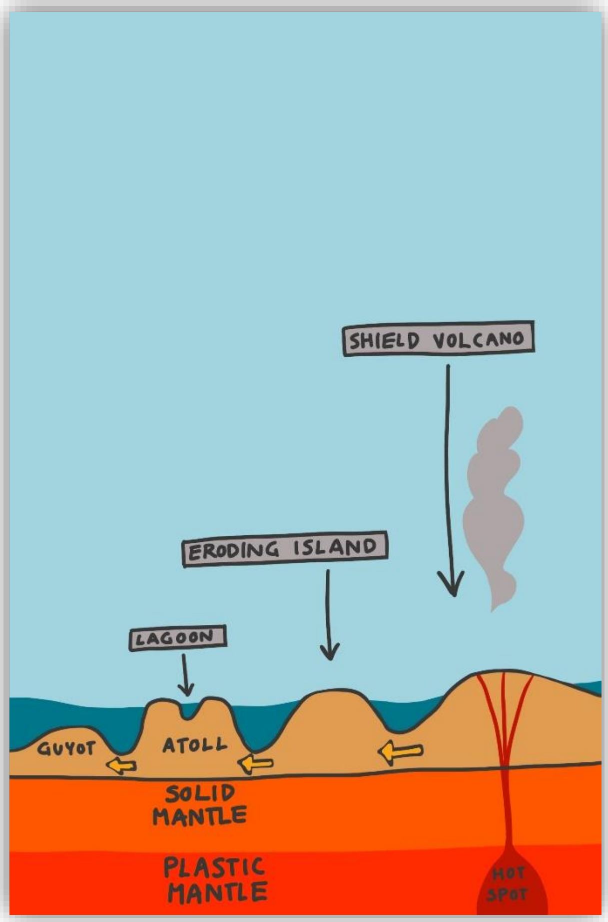




This process lowers the **pH** of the ocean, leading to ocean acidification, which weakens coral skeletons and disrupts their growth. Additionally, higher atmospheric CO_2 levels contribute to global warming, raising sea temperatures.

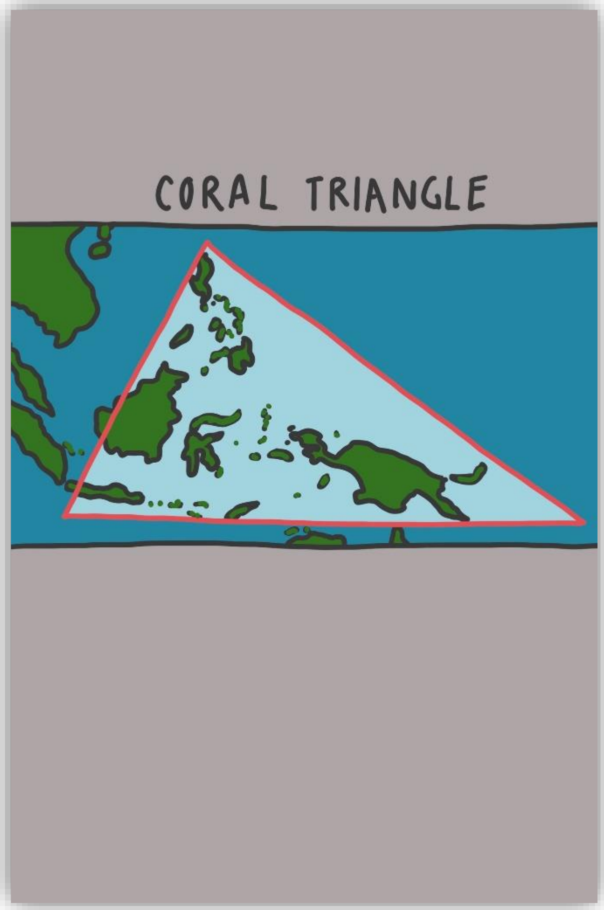
Corals are influenced by tectonic plates through **volcanic activity** in several ways. Volcanic eruptions **create new islands** and **seamounts** that serve as habitats for corals. These eruptions also provide hard substrates for coral attachment and can increase nutrient levels in surrounding waters, benefiting coral reef ecosystems. Additionally, tectonic activity can cause seismic events that may damage or reshape coral reefs.

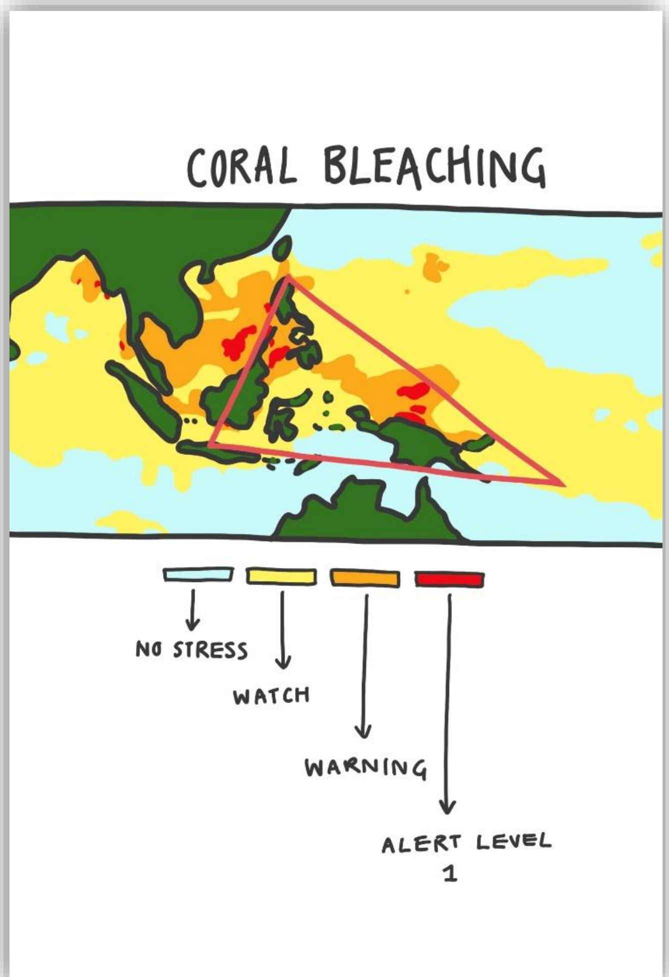




“**Plate tectonics** is a model that explains the origins of continents and oceans, folded rocks and mountain ranges, earthquakes and **volcanoes**, and continental drift.” (Webb, 2023)

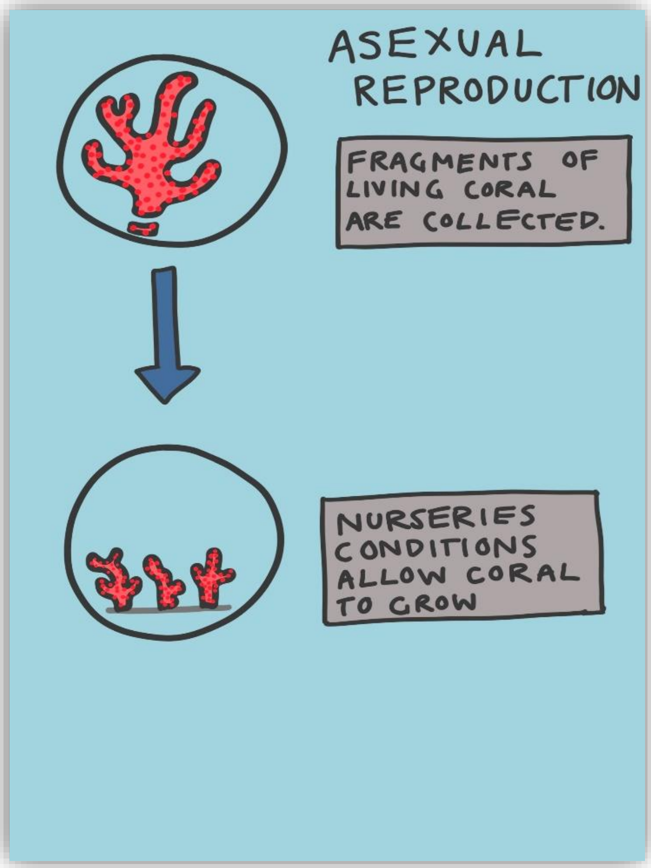
"The highest diversity coral reefs in the world, located in the Coral Triangle, are threatened by a variety of local stresses including pollution, overfishing, and destructive fishing in addition to climate change impacts, such as increasing sea surface temperatures (SSTs), and ocean acidification" (McLeod, 2010)





The coral triangle is a **biodiversity hotspot.** Coral biodiversity decreases with distance from the triangle. Drop offs of corals found on tectonic boundaries.

Coral reproduction is crucial for maintaining healthy reef ecosystems, but without active interventions, coral populations face severe risks. Burdett (2024) highlights that 'without active interventions, coral ecosystems are expected to collapse worldwide in the coming decades.'



Coral **propagation** and outplanting-based restoration support **natural recovery** of coral reefs. Mills (2023) notes that these methods help rejuvenate damaged reefs. Active restoration techniques further enhance coral growth by directly manipulating the reef environment to promote healthier coral ecosystems."

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