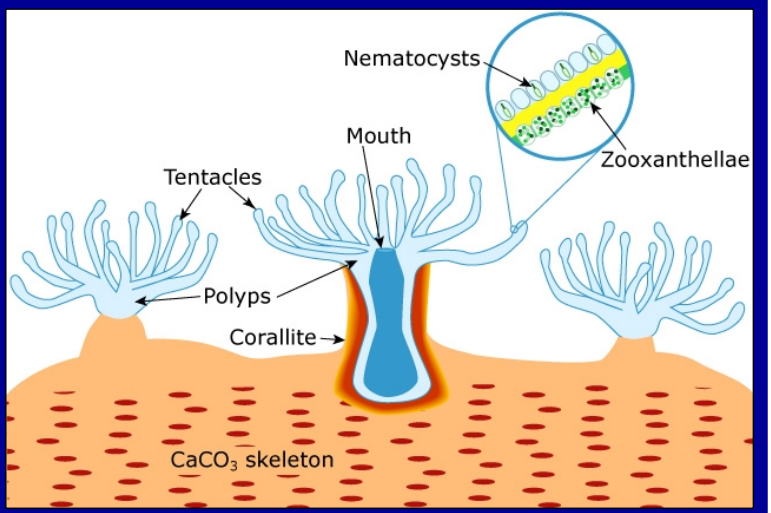
What are Corals?

Corals are living animals!

Corals have a mouth and a digestive system, getting their nutrition from food, making them an animal. Plants get their energy from the sun via photosynthesis.



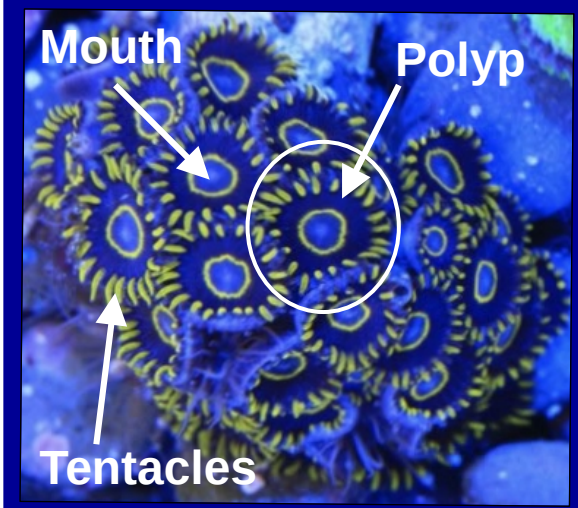
Corals are all mouth!

Corals are made up of many individual animals, known as polyps. Each polyp has a massive mouth compared to body size, each surrounded by a ring of tentacles with nematocysts (stinging cells). They use these to catch and immobilise prey, such as zooplankton (microscopic aquatic animals) and small shrimps. The food is passed to the mouth and into a body cavity where it is digested and later expelled.

Corals blur the distinction between Earth and Life

Corals are animals that create rock!

They absorb calcium and carbonate ions from the water and use it to make a limestone rock skeleton. Millions of corals together build larger structures called coral reefs – some are so big they can be seen from space, such as the Australian Great Barrier Reef!



How do corals breathe underwater?

Algae provides the coral with oxygen!

Most corals have a type of photosynthetic algae, called zooxanthellae, living in their cells.

The colourful world of corals

Why are corals so colourful?

Most corals have a type of photosynthetic algae, called Zooxanthellae, living in their tissues. This algae produces fluorescent chemicals that protects itself from the sun. This gives corals their pigmentation.

Zooxanthellae

How does the algae get inside the coral?

The tiny single-celled organisms are suspended in the water and simply enter the coral through its mouth! The coral can actually control how much it takes in and releases!

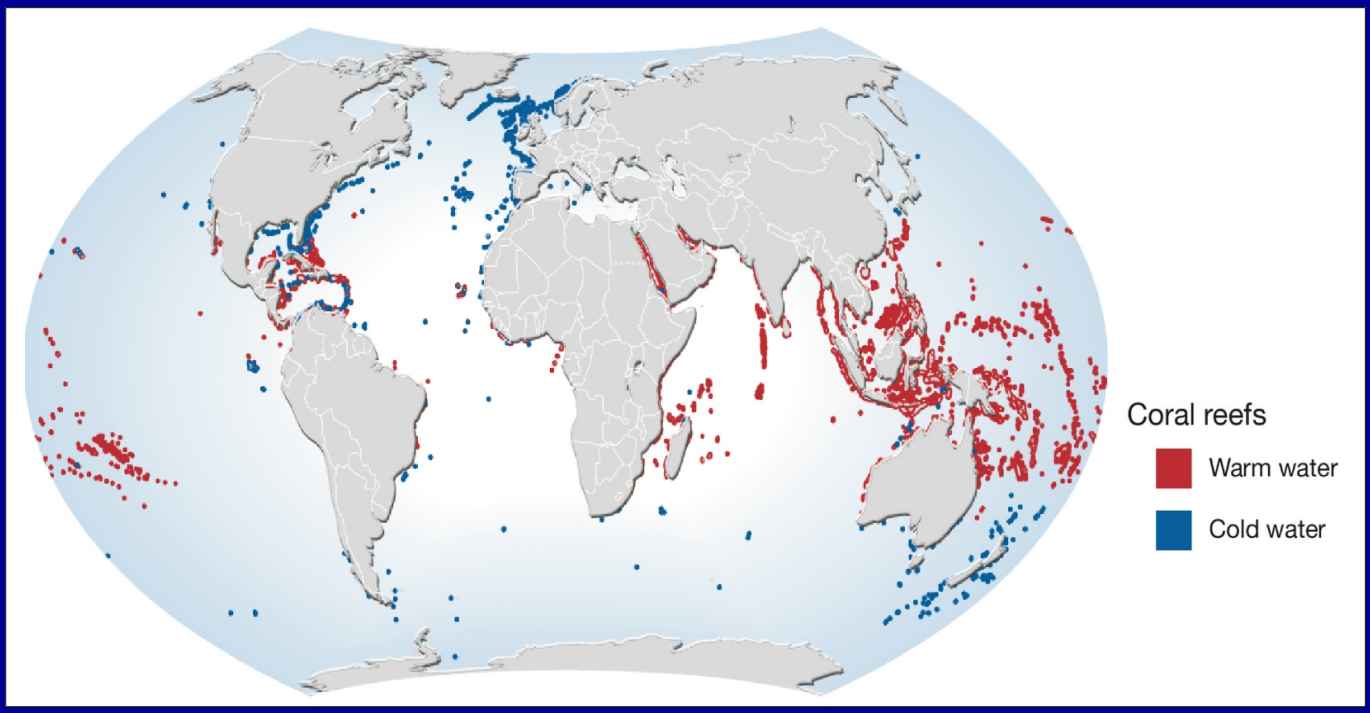
Algae allow coral to live!

Most corals can't survive without zooxanthellae algae. The algae benefit by removing the coral's waste products of respiration and using it for photosynthesis. In return, the algae produces oxygen and essential nutrients, such as glucose, glycerol, and amino acids. The coral uses these to make proteins, fats, and carbohydrates.

Up to 90% of the organic material photosynthetically produced by the zooxanthellae is transferred to the host coral tissue. Algae are the driving force behind the growth and productivity of a coral reef.

This vital **mutual relationship** is why corals almost behave like plants and are mainly found in clear, shallow, low nutrient waters where exposure to sunlight is greater.

Where can you find corals?

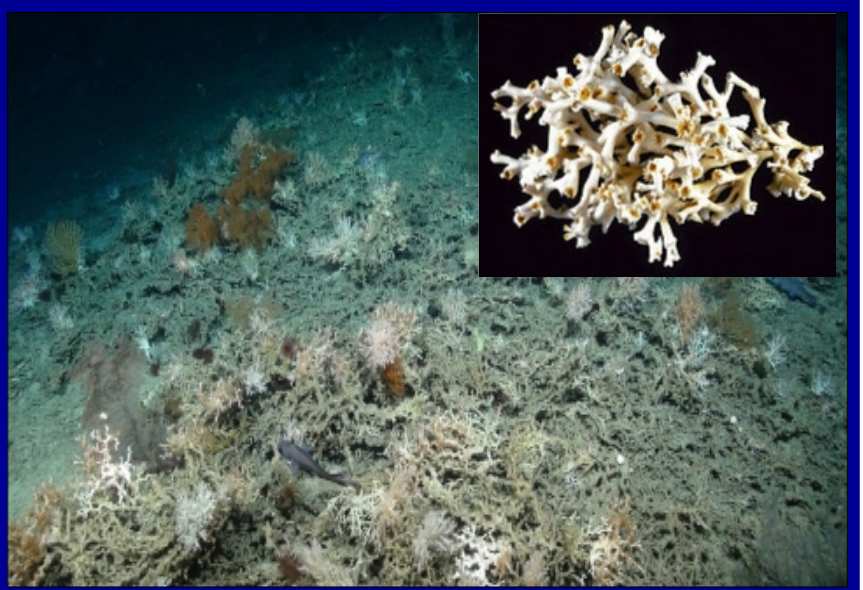


Coral reefs are formed by stony corals that require a very specific environment.

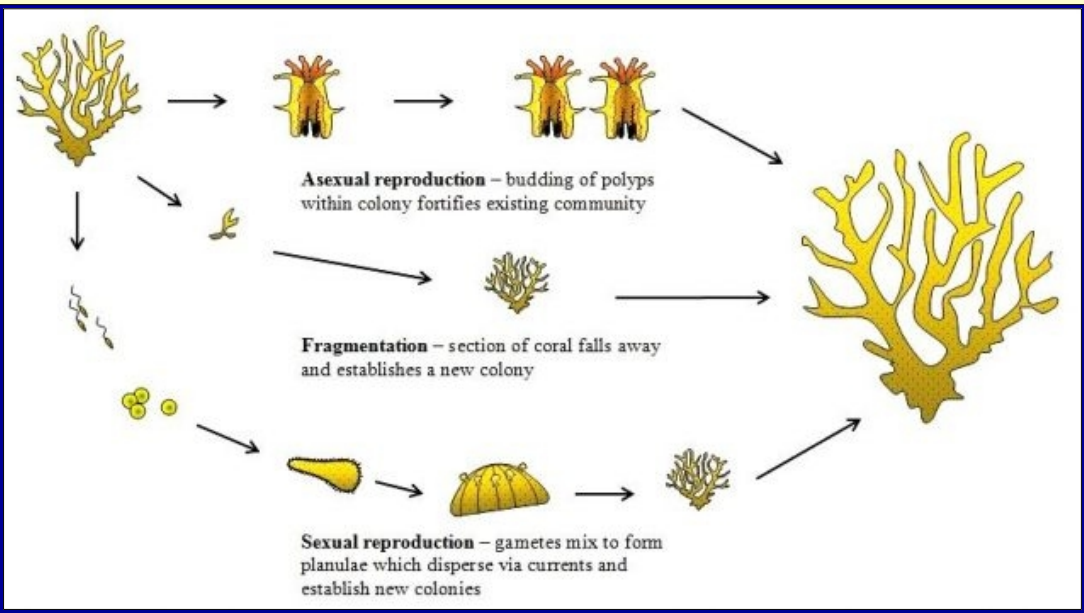
Coral cannot tolerate temperatures below 18°, and need salt water and good light. They are mainly found in warm, tropical and subtropical areas in the ocean's euphotic zone. This is where light penetration into the water is deep enough for photosynthesis to occur. These are mostly one type of coral – reef forming stony corals. Other types of coral include non-reef forming soft corals and deep water corals that live in cold, dark waters.

Deep cold water corals

are visibly different from shallow water corals as they lack the zooxanthellae in their tissue, making them pigment-less and white in colour. Such coral reefs can be found 400m deep off the coast of Scotland.



How do corals reproduce?



Corals can reproduce sexually and asexually!

Asexual reproduction produces genetically identical polyps, or clones. There are three methods:

1) **Budding** - a clonal polyp grows from a parent polyp and may detach to live on its own, to expand the colony or create a a new one.

2) **Fragmentation** – a piece of coral breaks away and establishes elsewhere 3) **Parthenogenisis** - an embryo develops within the coral without fertilisation by sperm.

There are two methods of sexual reproduction

1) **Broadcast spawners** have a synchronous mass release of eggs and sperm into the water column. The eggs are **fertilised externally** to form free-floating larvae called planulae. These float on the water surface, being transported by the current for about two days before swimming down to settle. They will then metamorphose into polyps and form new colonies.

2) **Brooders** fertilise their eggs **internally**. Sperm cells are released into the water and enter the polyps to fertilise the eggs. The polyps then release the larvae when they have developed.

Why are corals important?

Coral reefs are the rainforests of the Ocean!

They are one of the most important ecosystems in the world, supporting greater biodiversity than any other, including tropical rainforests!

They support 25% of all marine species, including over 800 species of hard corals, 4000 species of fish, and over a million species of other animals!

Coral reefs support half a billion people worldwide!

They are a vital food source, especially to the 275 million people that live within 20 miles of a coral reef. About half of all managed fisheries rely on coral reefs and related habitats for a part of their catches' life cycle.

Other areas include tourism, recreation, and commercial businesses like restaurants. Commercially they are worth BILLIONS of dollars!

Medicines and treatments are now being developed from coral reef animals and plants, targeting common human ailments such as cancer, arthritis, human bacterial infections, viruses, and other diseases.

Why are Corals important?

Coral reefs act as sea defences!

Coral reef structures buffer shorelines against 97% of the energy from waves, storms, and floods, helping to prevent loss of life, damage to infrastructure, and coastal erosion. When reefs are damaged or destroyed, this natural sea defence is lost.

The Australian Great Barrier Reef

The Australian Great Barrier Reef located along the NE coast of Queensland, is a whopping **1429 miles long and 20,000 years old.** It contains over 3000 individual coral reefs and supports over 9000 known species. It is a natural wonder attracting 1.6 million visitors every year.

Its biodiversity value is priceless, but it has an estimated commercial & ecosystem value of $66 billion. This doesn't even include its value in reducing wave action. It acts as a buffer to coastal erosion, thus protecting the cities and towns along the Queensland coastline.

The Belize Barrier Reef

The Belize Barrier Reef is 2nd to the Great barrier reef, extending 190 miles along the Caribbean coast of Belize, central America. It also has great diversity, home to many vulnerable species such as the American Crocodile and the world's largest population of American Manatees. It plays a major role in protecting the coastline from powerful natural phenomena like hurricanes and storms.

Why are corals in danger?

GLOBAL WARMING!

Coral Bleaching Corals have a low tolerance to temperature change. When the temperature of the sea water gets too warm, the symbiotic algae produces chemicals that are harmful to the coral. In response, the coral expels the algae from its system.

The algae give a coral its colour. Corals that expel their algae turn white!

The coral doesn't die at this stage but is incredibly stressed, losing its primary energy source and becoming vulnerable to disease. Corals are capable of recovering if conditions are reversed within months, but complete coral reef ecosystem recovery can take decades. 60-70% of bleached corals don't recover.

Increasing ocean temperatures are the leading cause of coral bleaching but over-fishing, low temperatures, over exposure to sunlight in shallow waters when temperatures are high, and pollution, can all also cause this phenomenon.

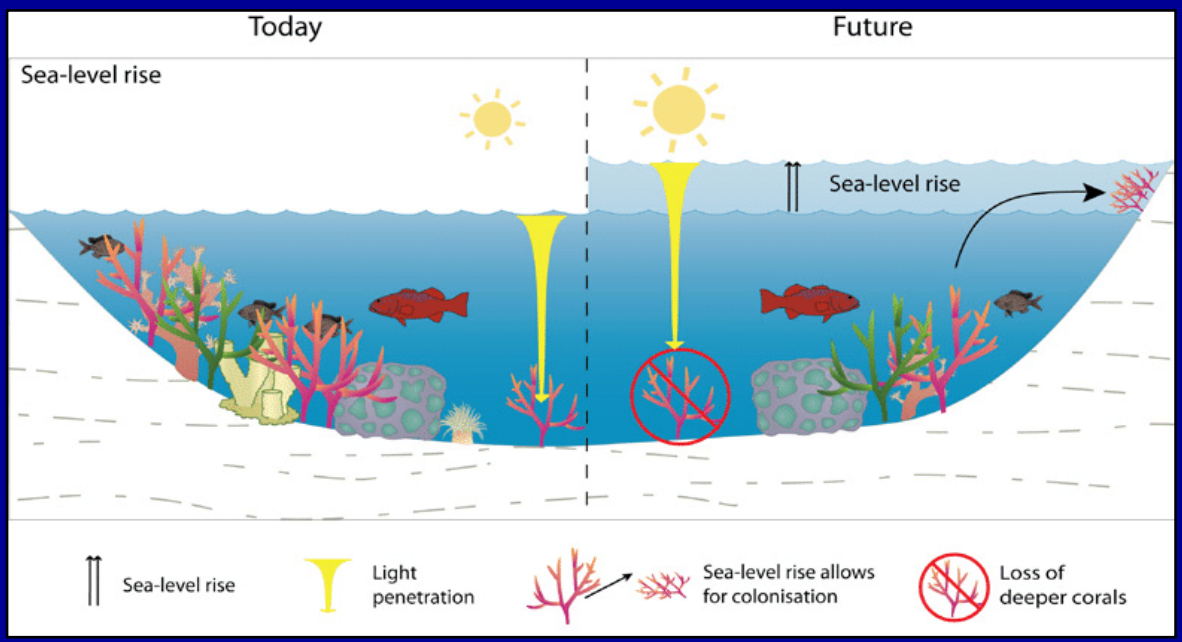
In 2005, the Caribbean lost half of its coral reefs in one year due to a massive bleaching event.

Some scientists predict that 90% of global reefs will experience severe bleaching annually by 2055.

The Australian Great Barrier Reef experienced three mass coral bleaching events in 2016, 2017 and 2020. It is predicted that it will be hit with extreme levels of coral bleaching 5 x each decade by 2050 if global warming is kept just below 2C. Current optimistic targets are 1.5C. Sadly, the Great Barrier Reef has already lost half of its corals since 1995!

Why are corals in danger?

GLOBAL WARMING!



Sea level rise is predicted to submerge shallow water corals into deeper water, where they will receive less sunlight, reducing their vital energy source and grow slower. Corals can colonise 'new' shallower waters but this is a slow process and inhibited by other factors, as explained below.

Worsening weather Hurricanes, cyclones, and typhoons are becoming stronger as sea surface temperatures rise. These batter and damage coral reefs. Heavy rainfall also erodes coastal lands and sends more polluted runoff into the ocean.

Ocean Acidification Oceans absorb carbon dioxide (CO_2) emissions as the CO_2 binds with sea water to form carbonic acid. This makes oceans more acidic and dissolves the coral's limestone rock skeletons. Additionally, lower pH results in reduced carbonate, making less available for reef-building corals to grow their skeletons. Weaker skeletons make corals more vulnerable to disease and destruction by storms.

200 million people in coastal communities could be displaced if coral growth does not keep up with sea level rise.

48% of fossil fuel emissions are absorbed by the ocean. When exposed to high levels of CO_2, corals stop being productive and their risk of bleaching increases by up to 50%.

Remember, coral reefs support 25% of all marine species, it's not just the corals in danger!

Why are corals in danger?

Direct/Local Threats

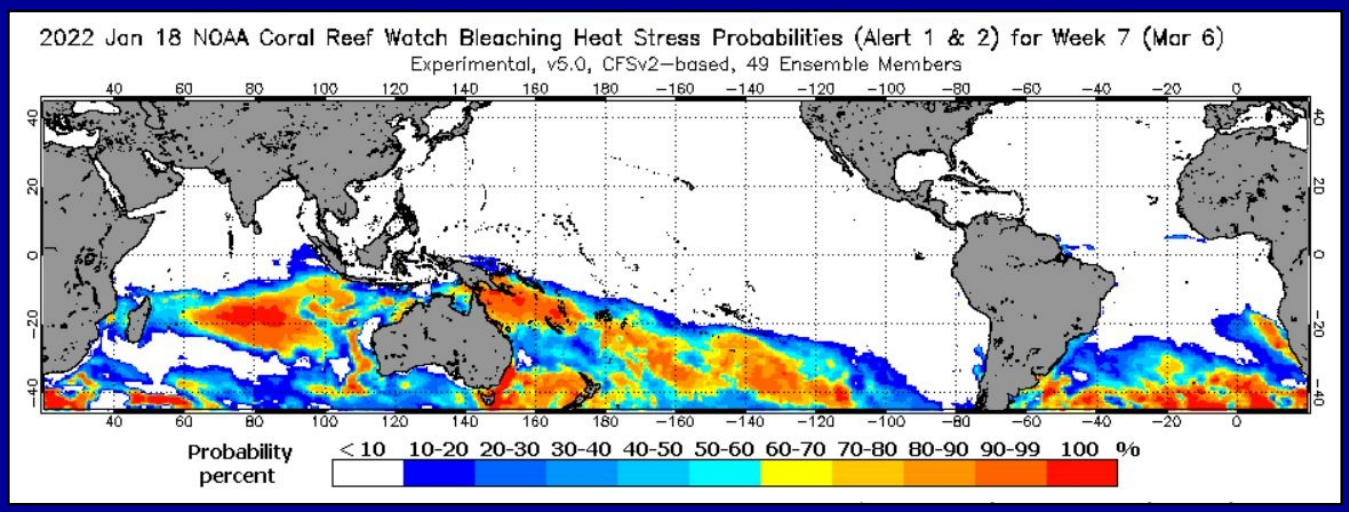
Overfishing A whopping 55% of the world's coral reefs are affected by overfishing. When fish populations decline, ecosystems become unbalanced. Unsustainable fishing practices, such as blast (dynamite) fishing, can destroy entire sections of coral reef, a single blast destroys 64 square feet of reef! Fortunately, this practice is now being phased out.

Habitat destruction Unsustainable tourism and coastal development can cause lasting damage on a coral reef. Touching or standing on a coral reef or constructing buildings and roads too close to the shoreline without appropriate mitigations can quickly damage a reef.

Land-based pollution 25% of global coral reefs are affected by agricultural runoff. Wastewater can also be via sewage, industrial waste etc. Wastewater introduces chemicals and bacteria that are harmful to coral reefs and humans. It also brings nutrients (especially phosphorus) which can encourage an excessive growth of algae that smothers coral.

Crown-of-Thorns Starfish (COTS) are a ravenous coral predator, growing over 14 inches across with up to 21 arms! Covered with sharp stinging spines, they're almost immune to predation. They are a big problem for tropical coral reefs; their population experiences outbreaks caused by the over fishing of predatory fish that eat COTS, such as the Humphead wrasse. It's highly sought after in the South-East Asian live fish trade. The COTS are left unchecked to reproduce, eat coral and destroy fish habitat. Thousands have been eradicated but it's impossible to keep up with their rate of reproduction. The best solution is to ban fishing of Apex predators such as the Humphead Wrasse.

What are scientists doing to help corals?



Monitoring and Mapping

The US's National Oceanic and Atmospheric Administration (NOAA) is responsible for the conservation of US reef ecosystems. Using high-resolution satellite imagery and Global Positioning Satellite (GPS) technology, NOAA has made detailed digital maps of reefs in Puerto Rico, the U.S. Virgin Islands, and many Hawaiian Islands.

Coral Reef Watch Programme

Uses remote sensing, modelling and data to study and monitor global coral reef ecosystems, see above. This is the only global early-warning system of changes to coral reef environments, allowing detection of harmful algal blooms that can smother reefs and to predict coral bleaching events.

Coral Farming

Coral Fragments (or frags) can safely be cut off from living corals and 'propagated' in nurseries. They are lined up on racks on the ocean floor and after months of care, the frags are translocated to a dying coral reef.

However, this is a slow process, scientists have found micro fragmenting in lab environments is 50 x faster! There's even a method of 'assisted evolution' where frags are exposed to controlled conditions, making them more tolerant of warming temperatures and acidification.

What can I do to help corals?

It's not your fault! **Just 100 companies in the world have been found responsible for 71% of the global Greenhouse Gas (GHG) emissions that caused global warming since 1998!**

HOWEVER, the choices we make in how we live our lives make a big impact too; in 2016, road transport, energy use in residential buildings, agriculture, land use & forestry were accountable for 12%, 11%, 18.4% respectively of all global GHG emissions.

1) YOU CAN Live more sustainably

- Reduce plastic consumption & recycle
- Buy economical cars/use public transport/cycle/commute less
- Avoid pesticides, plant native trees.
- Reduce meat & dairy consumption/grow your own food/eat local & seasonal produce
- Holiday in the UK instead of flying abroad or take alternative transport i.e. trains and ferries
- Buy second hand clothes, shoes, furniture/tools etc.

2) YOU CAN Be a smart consumer/tourist.

- Use reef-safe sunscreen
- Avoid purchase items made from any animal products including corals and shells.
- Do your research before travelling, making sure certain activities and tour providers are coral friendly.
- Support businesses that are committed to protecting the environment
- Use your voice to push other companies to do better.

3) YOU CAN Advocate for high-level policy change

- Let your representatives (MPs, councils & governments) know you care about climate change.
- Vote for parties and candidates that commit to reducing emissions, tackling climate change, and protecting the environment. Locally this could mean asking for improving services like public transport and recycling, or investing in infrastructure like vehicle charging points and cycle lanes.