Coral Reefs!

A coastal ecosystem

What are Coral Reefs?

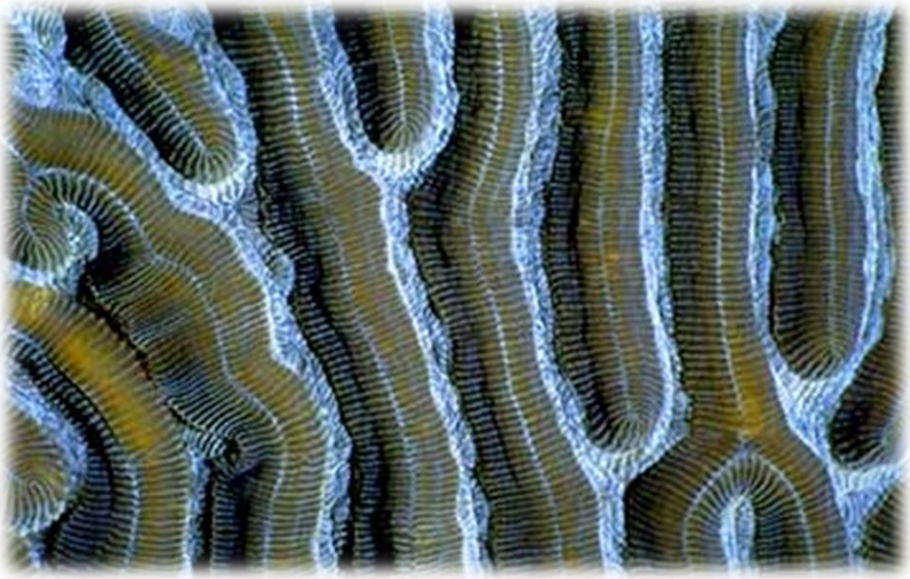
- Appearing in the fossil record more than 400 million years ago, corals are extremely ancient animals that evolved into modern reef-building forms over the last 25 million years.

What are Coral Reefs?

- Coral reefs are unique, large living structures on earth and complex systems.
- Rivaling old growth forests, well-developed reefs reflect thousands of years of history.

What are Coral Reefs?

- Coral is a limestone formation formed in the sea by millions of tiny animals called polyps. Each animal is tinier than your pinky nail, and grows very slowly.



What are Coral Reefs?

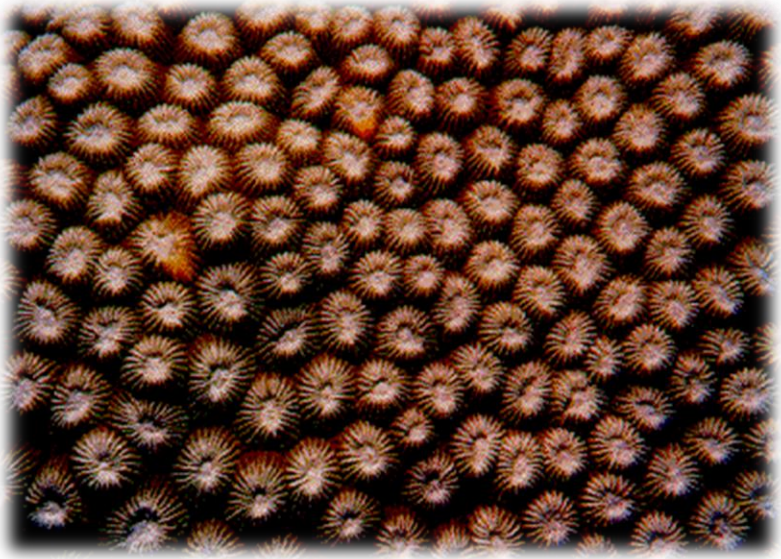
- Each polyp houses a plant/algae called zooxanthellae

- The zooxanthellae have a symbiotic relationship with the coral

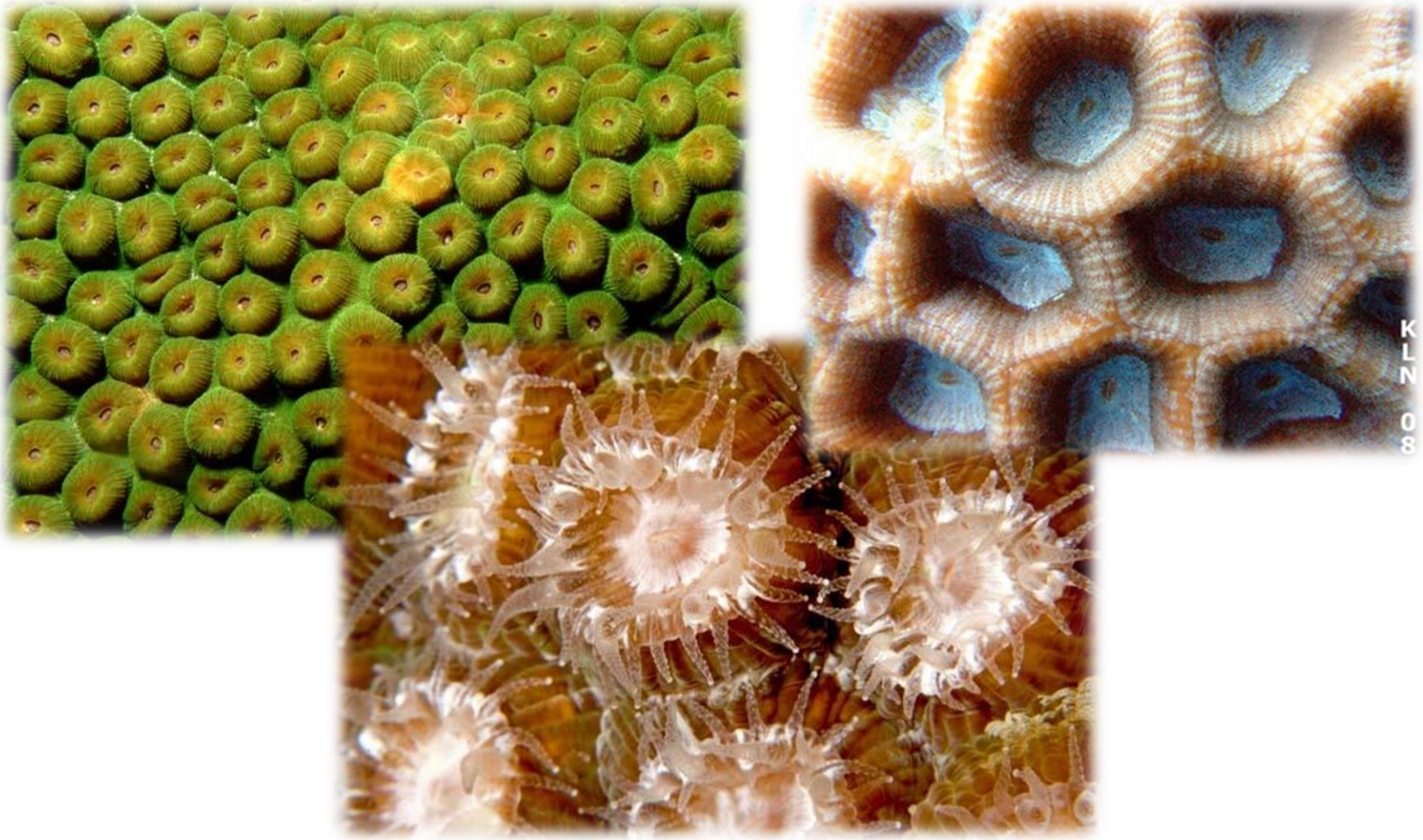
- The Zooxanthellae provide the coral with organic carbon products from photosynthesis, in turn they receive nutrients, carbon dioxide and an elevated position with access to sunshine.

Coral Polyps

- Coral Polyps are created when free-swimming coral larvae (planula) settle on a reef structure.
- Most coral polyps live together in colonies.
- Polyps secrete calcium carbonate ($CaCO_3$) creating additional reef structure.
- The polyp then divides into thousands of clones that inhabit the limestone skeleton.

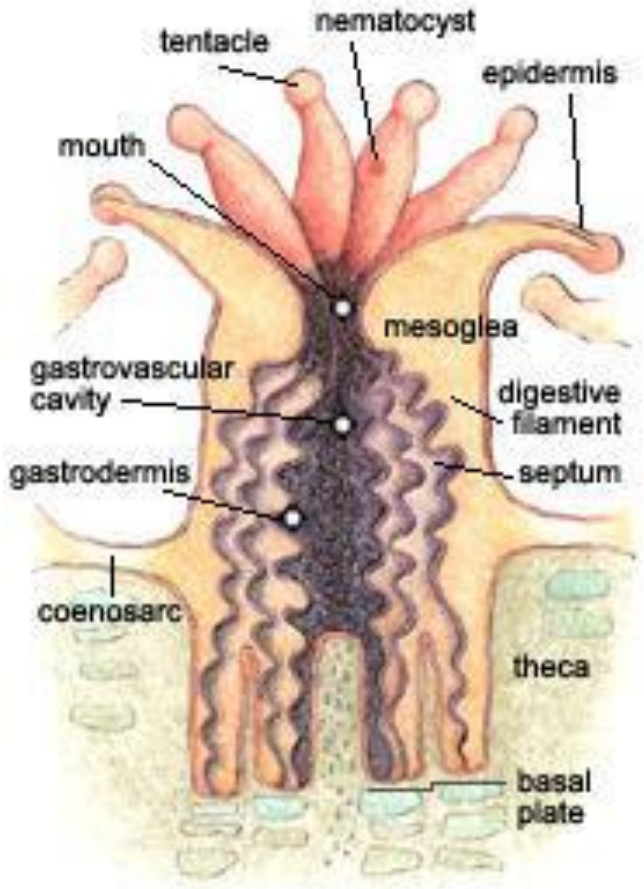


Coral Polyps



Coral Polyps

- All coral polyps share two basic structural features with other members of their phylum.
- The first is a gastrovascular cavity that opens at only one end.
- At the opening to this cavity, commonly called the mouth, food is consumed and some waste products are expelled.



Coral Polyps

- A second feature all corals possess is a circle of tentacles, extensions of the body wall that surround the mouth.

- Tentacles help the coral to capture and ingest plankton for food, clear away debris from the mouth, and act as the animal's primary means of defense.

Coral Polyps

- When the animals die, they leave behind limestone "skeletons" that become the foundations of barrier reefs and ridges.

From Polyp to Reef

- Massive reef structures are formed when each stony coral polyp secretes a skeleton of $CaCO_3$.
- Most stony corals have very small polyps, averaging 1 to 3 mm in diameter, but entire colonies can grow very large and weigh several tons.
- Although all corals secrete $CaCO_3$, not all are reef builders.

Types of Coral

- Corals are divided into two kinds and both are stationary on the ocean bottom.

Hard Corals

Soft Corals

Hard Corals

- There are over 3,000 species of hard corals, which are also known as stony corals or hexacorals.
- Hard corals create large, strong limestone skeletons that eventually become rock, providing large structures to facilitate future coral growth.

Soft Corals

- Gorgonians, or soft corals, such as sea fans, sea whips, and sea rods, sway with the currents and lack an exoskeleton.
- These corals feed by catching food as water passes through the openings in the fan

Reef Building Corals

- Corals cannot survive in water cooler than 65 °F (18 °C), therefore coral reefs are found mostly in warm, shallow, and tropical seas.

- Reef-building corals are restricted in their geographic distribution.

- This is because the algal-cnidarian symbiotic machinery needs a narrow and consistent band of environmental conditions to produce the large quantities of limestone necessary for reef formation.

Reef Building Corals

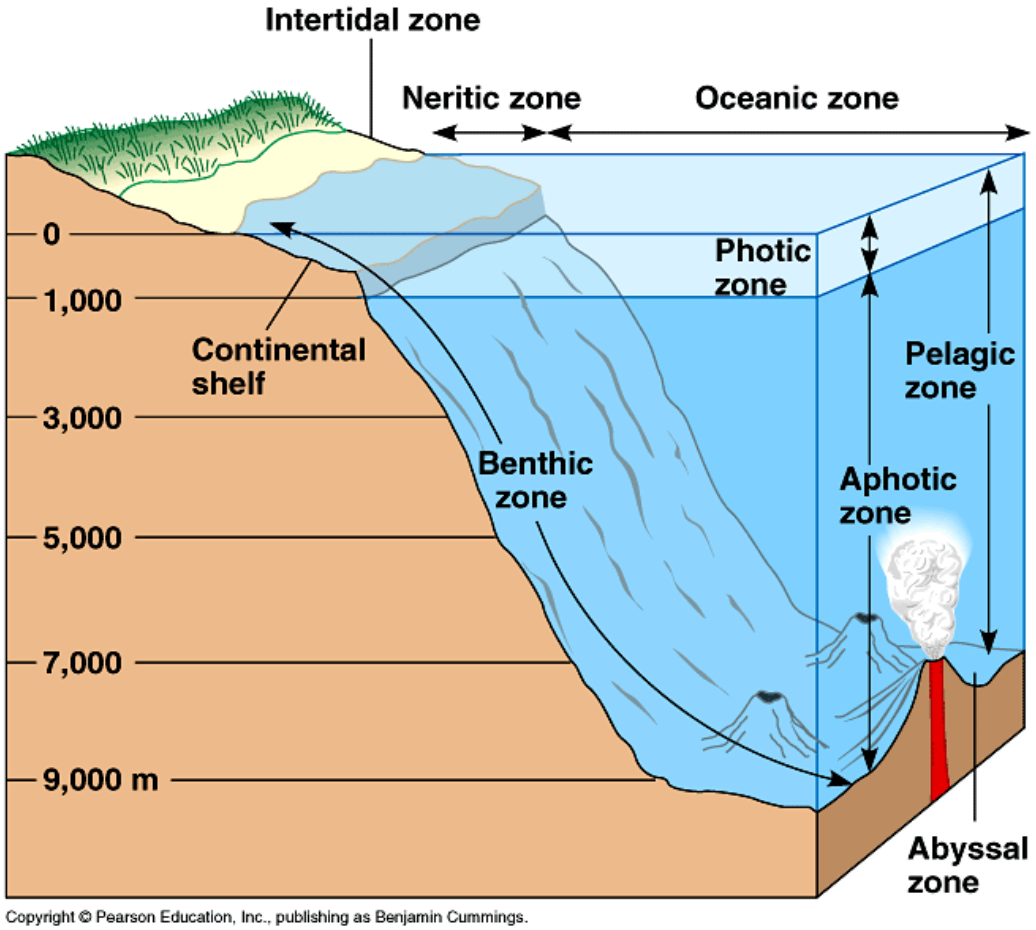
- Some reef building corals include:
  - Mountainous star coral (Orbicella faveolata),
  - Boulder star coral (Orbicella annularis)
  - Great star coral (Montastraea cavernosa)
  - Massive starlet coral (Siderastrea siderea)

Optimal Conditions for Growth

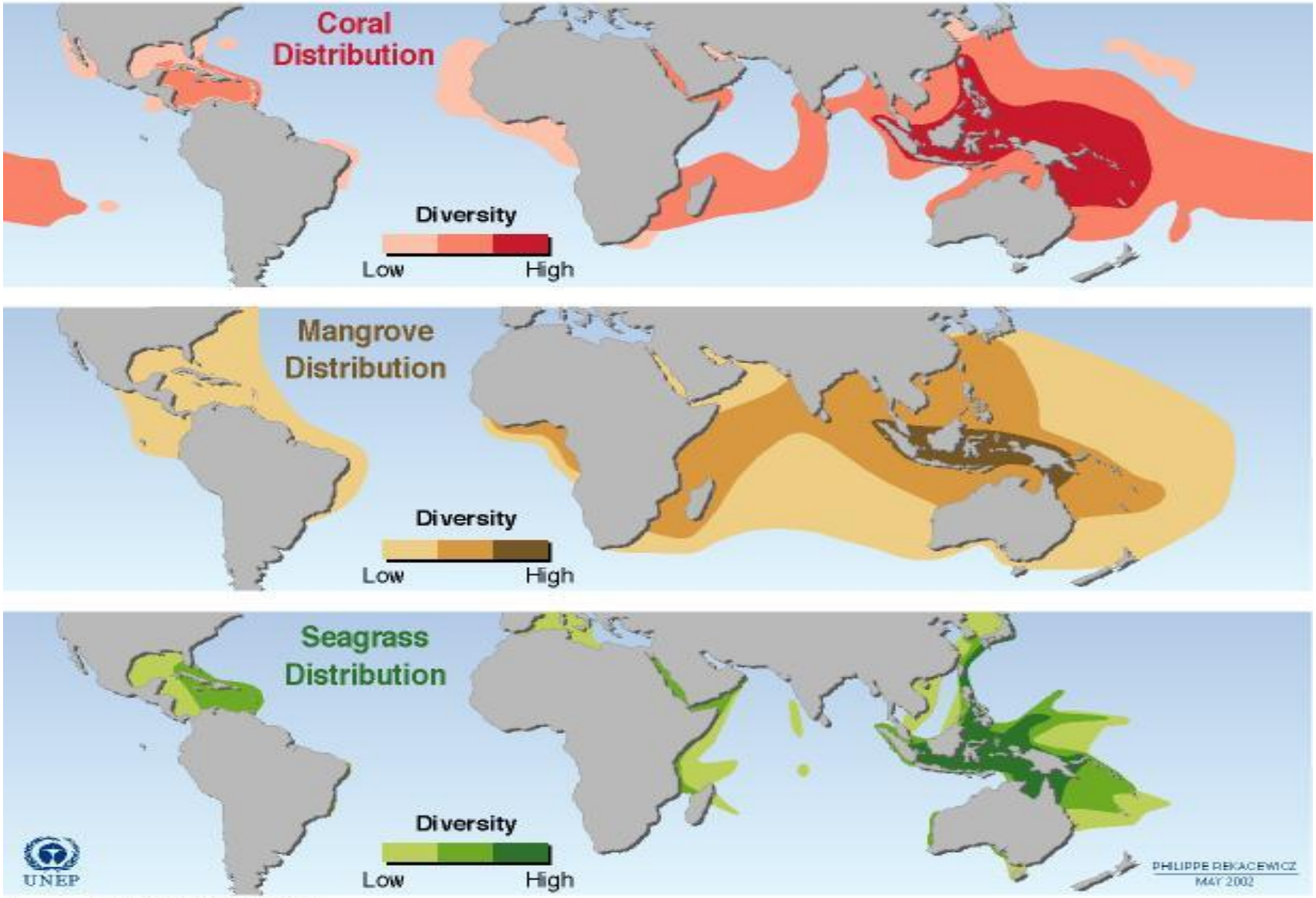
- Many corals grow optimally in water temperatures between 23°C (73°f) and 29°C (85 °F), but some can tolerate temperatures as high as 40°C (104°F) for limited periods of time.
- Most require very salty (saline) water ranging from 32 to 42 parts per thousand.
- The water must also be clear to permit high light penetration.

Optimal Conditions for Growth

- The corals' requirement for high light also explains why most reef-building species are restricted to the euphotic (light penetration) zone, approximately 70 m.



Global Distribution of Coral, Mangrove and Seagrass Diversity



Source : UNEP-WCMC, 2001.

Coral Reef Distribution Map

Types of Corals- Star Coral

- This is what it looks like during the day, but at night it extends its polyps to feed.

Types of Corals- Fire Coral

- If touched, fire coral can cause mild to moderate burning sensations.
- This is the result of cnidocytes embedded in their calcareous skeleton. These cnidocytes contain nematocysts which inject venom when touched.

Types of Corals- Brain Coral

- This coral lives in shallow water. It can come in different colors of brown, green and light brownish yellow.
- This coral is commonly found washed up along shorelines here in the Cayman Islands.

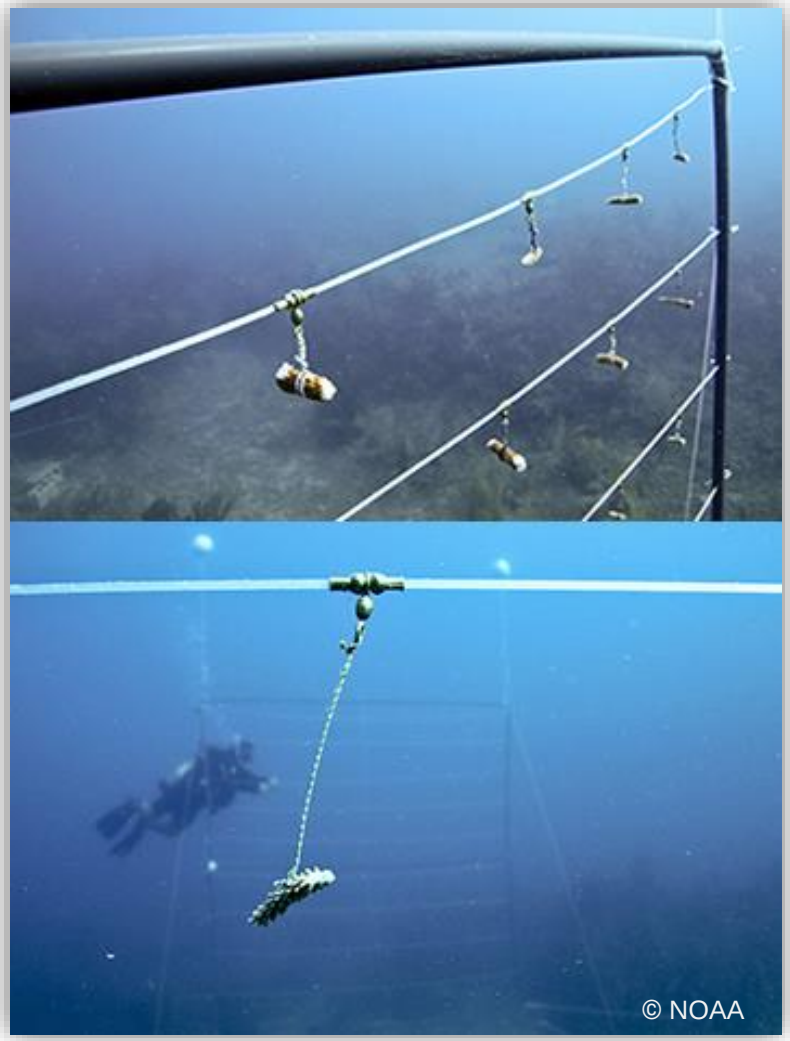
Types of Corals- Elkhorn Coral

- Elkhorn coral gets its name from the antler-like shape of its colonies.
- It is a fast-growing species and is considered one of the most important reef-building species in the Caribbean.
- What once was one of the most common corals on the reef throughout its range, elkhorn is now very rare and is considered critically endangered by reef scientists.

Types of Corals- Staghorn Coral

- Like Elkhorn coral, Staghorn is a type of branching hard coral.
- Staghorn is typically found in shallow waters (10-60 feet).
- In the early 1980s, a severe disease event caused major mortality amongst the species reducing the population to less than 3 percent of its former abundance.
- Luckily, this coral is relatively easy to fragment, grow and replant!

Growing Staghorn Coral



Types of Corals- Sea Fan

- Although it looks like it is made of a series of branches, its actually an animal with a coral skeleton.

Types of Corals- Tube Sponge

- Sponges are not corals but they are one of the simplest of animals.
- As water passes through the sponge it brings food and oxygen to this creature.
- Sponges come in many shapes and gives the reef a lot of beautiful colours!

Benefits of Coral Reefs

- **Habitat:** Coral reefs provide homes to over 1 million aquatic species.
- **Income:** Coral reefs facilitate countless jobs in tourism and scientific research and conservation worldwide!
- **Food:** Coral reefs support healthy fish populations which can be sustainably fished as a source of food, especially in small island nations.
- **Protection:** Coral reefs act as natural barrier protecting coastlines from large waves.
- **Medicine:** Many modern medicines have been derived from coral reefs.

Threats to Coral Reefs

Some threats to Coral reefs include:

- Coral Bleaching
- Costal Development
- Sedimentation
- Eutrophication
- Destructive Fishing Practices
- Careless Tourism
- Invasive Species

Threats to Coral Reefs

Coral Bleaching

- When a coral bleaches, it is not dead.
- When a coral becomes stressed, the zooxanthellae are either expelled or “leave “the coral skeleton.
- Some stresses like temperature of nutrient deficiencies can be alleviated.
- If the stress is alleviated, the zooxanthellae can return to the skeleton.

CORAL BLEACHING

Have you ever wondered how a coral becomes bleached?

HEALTHY CORAL

1 Coral and algae depend on each other to survive.

Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral's primary food source and give them their color.

STRESSED CORAL

2 If stressed, algae leaves the coral.

When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral's tissue.

BLEACHED CORAL

3 Coral is left bleached and vulnerable.

Without the algae, the coral loses its major source of food, turns white or very pale, and is more susceptible to disease.

WHAT CAUSES CORAL BLEACHING?

Change in ocean temperature
Increased ocean temperature caused by climate change is the leading cause of coral bleaching.

Runoff and pollution
Storm generated precipitation can rapidly dilute ocean water and runoff can carry pollutants — these can bleach near-shore corals.

Overexposure to sunlight
When temperatures are high, high solar irradiance contributes to bleaching in shallow-water corals.

Extreme low tides
Exposure to the air during extreme low tides can cause bleaching in shallow corals.

NOAA's Coral Reef Conservation Program
http://coralreef.noaa.gov/

Threats to Coral Reefs

Costal Development

- Costal Development can cause direct and indirect impacts to coral reefs.
- Some of these impacts include:
  - *Reduction of Habitat*
  - *Increased usage of the reef (tourism)*
  - *Pollution*
  - *Sedimentation*
  - *Eutrophication*

Threats to Coral Reefs

Sedimentation

- When an increased number of particles enter the ocean.
- Sedimentation is typically caused by
- Costal Development
- Removal or destruction of natural buffer zones like mangroves and seagrass.
- When Sediment enters the water and settles on the bottom it can smother coral and reduce light penetration to the seafloor

Threats to Coral Reefs

Destructive Fishing Practices

- Fishing can be harmful to coral reefs in many ways.
- Some destructive fishing practices include:
  - Dynamite fishing
  - Long lining
  - Trolling nets
  - Overfishing and Bycatch
  - Cyanide fishing
- Discarded fishing gear is also a major threat to all marine life.

Threats to Coral Reefs

Careless Tourism

- Anchor Damage/running over reefs
- Touching/stepping on coral
- Plastic Pollution
- Touching/harassing marine organisms
- Taking of reef animals

Threats to Coral Reefs

Invasive Species

- A non-native species whose introduction does or is likely to cause economic or environmental harm.
- Invasive species can be introduced by humans or through climate change
- These species can cause harm to an environment in many ways. Such as:
  - Prey on native species
  - Destroy habitats
  - Reduce resources for native species

What can you do to promote healthy Coral Reefs?

Now that we have talked about why coral reefs are important and some of the threats they are facing, lets talk about what we can all do to help protect them!

- Educate family and friends
- Reduce your carbon footprint
- Use reef safe sunscreen
- Eat sustainable seafood options
- Reduce your single use plastic consumption

and join local beach clean ups!

10 ways to protect CORAL REEFS

Corals are already a gift. Don't give them as presents.

It takes corals decades or longer to create reef structures, so leave them on the reef.

CHECK SUNSCREEN ACTIVE INGREDIENTS.

Seek shade between 10 a.m. and 2 p.m., use Ultraviolet Protection Factor (UPF) sunwear, and choose sunscreens with chemicals that don't harm marine life. For more information, visit *oceanservice.noaa.gov/sunscreen*.

Long-lasting light bulbs - ARE A - BRIGHT IDEA

Energy efficient light bulbs reduce greenhouse gas emissions. Climate change is one of the leading threats to coral reef survival.

Choose sustainable seafood.

Learn how to make smart seafood choices at www.FishWatch.gov.

IF YOU DIVE DON'T TOUCH.

Coral reefs are alive. Stirred-up sediment can smother corals.

BE A MARINE DEBRIS CRUSADER.

In addition to picking up your own trash, carry away the trash that others have left behind.

CONSERVE WATER

The less water you use, the less runoff and wastewater that eventually find their ways back into the ocean.

Volunteer!

Volunteer in local beach or reef cleanups. If you don't live near the coast, get involved in protecting your watershed.

Don't send chemicals into our waterways.

Nutrients from excess fertilizer increases algae growth that blocks sunlight to corals.

Practice safe boating.

Anchor in sandy areas away from coral and sea grasses so that the anchor and chain do not drag on nearby corals.

oceanservice.noaa.gov

Corals can’t be replaced!

Coral may look tough, but its very sensitive. The reefs we have today were formed over 100s of thousands of years, and it would take just as long to grow back