Coral Reefs

- Where are they found?
- How fast can they grow?

Coral Reefs

- Clear, shallow, nutrient poor water
- Tropical
- Grow slowly, 2 mm/year
- Massive individual corals: 0.5-1.0cm/yr
- Branching ind. Corals: 10-20 cm/yr

2 types of corals

- 1: Soft Corals

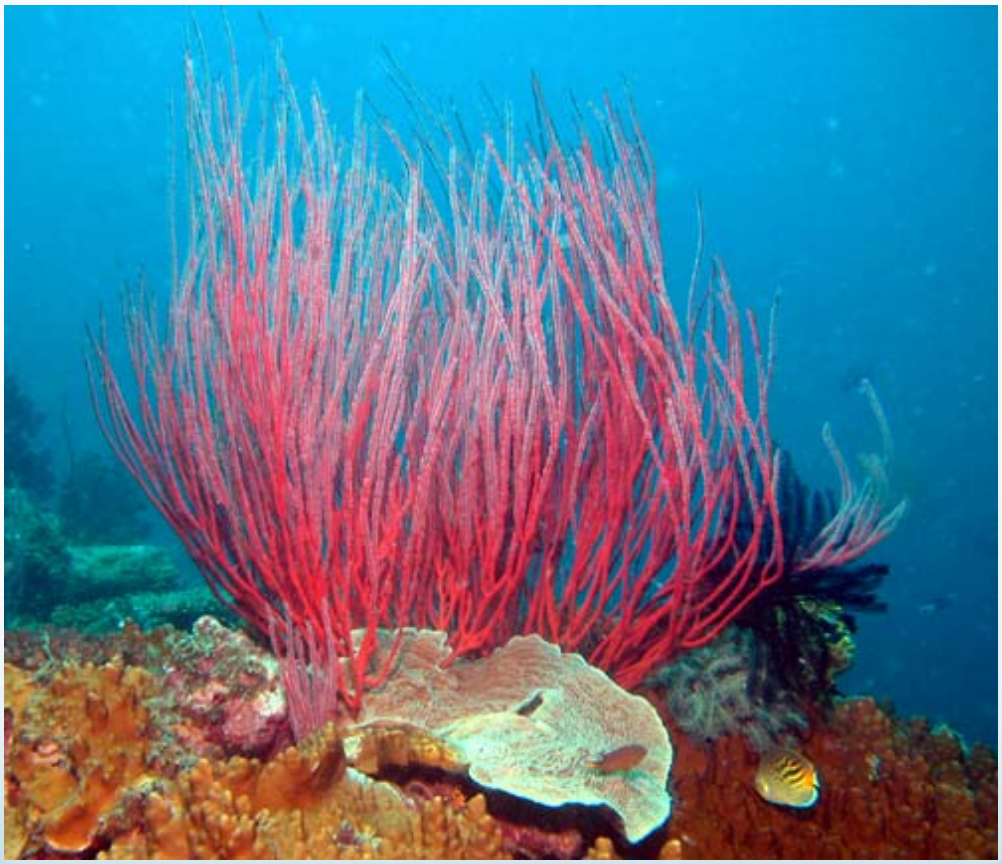
- Polyps secrete skeleton made of keratin (like fingernails)
- Decomposes (doesn't contribute to building coral reefs)

Keratin - Soft coral

Soft coral -sea fans

Sea pens

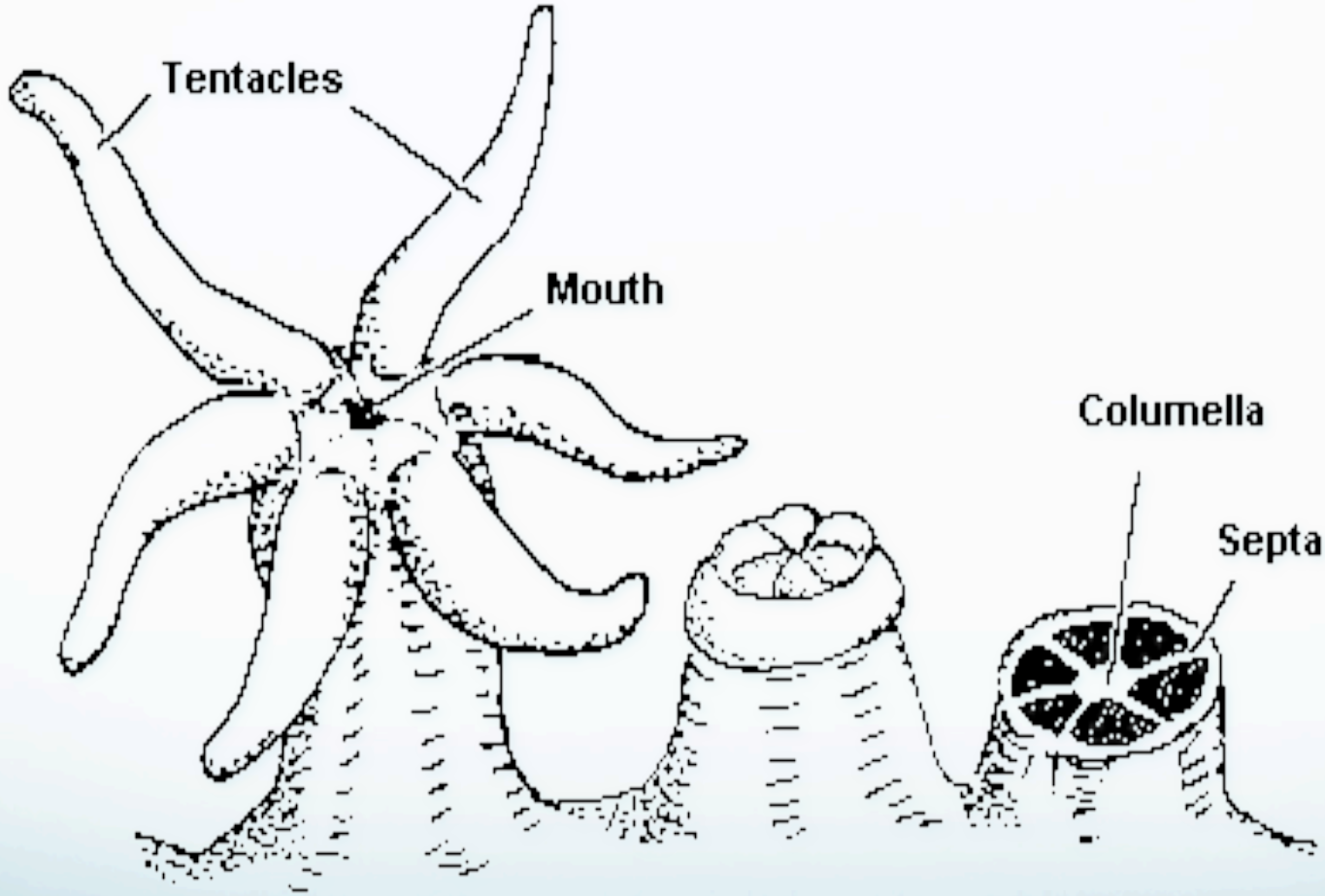
Sea whips



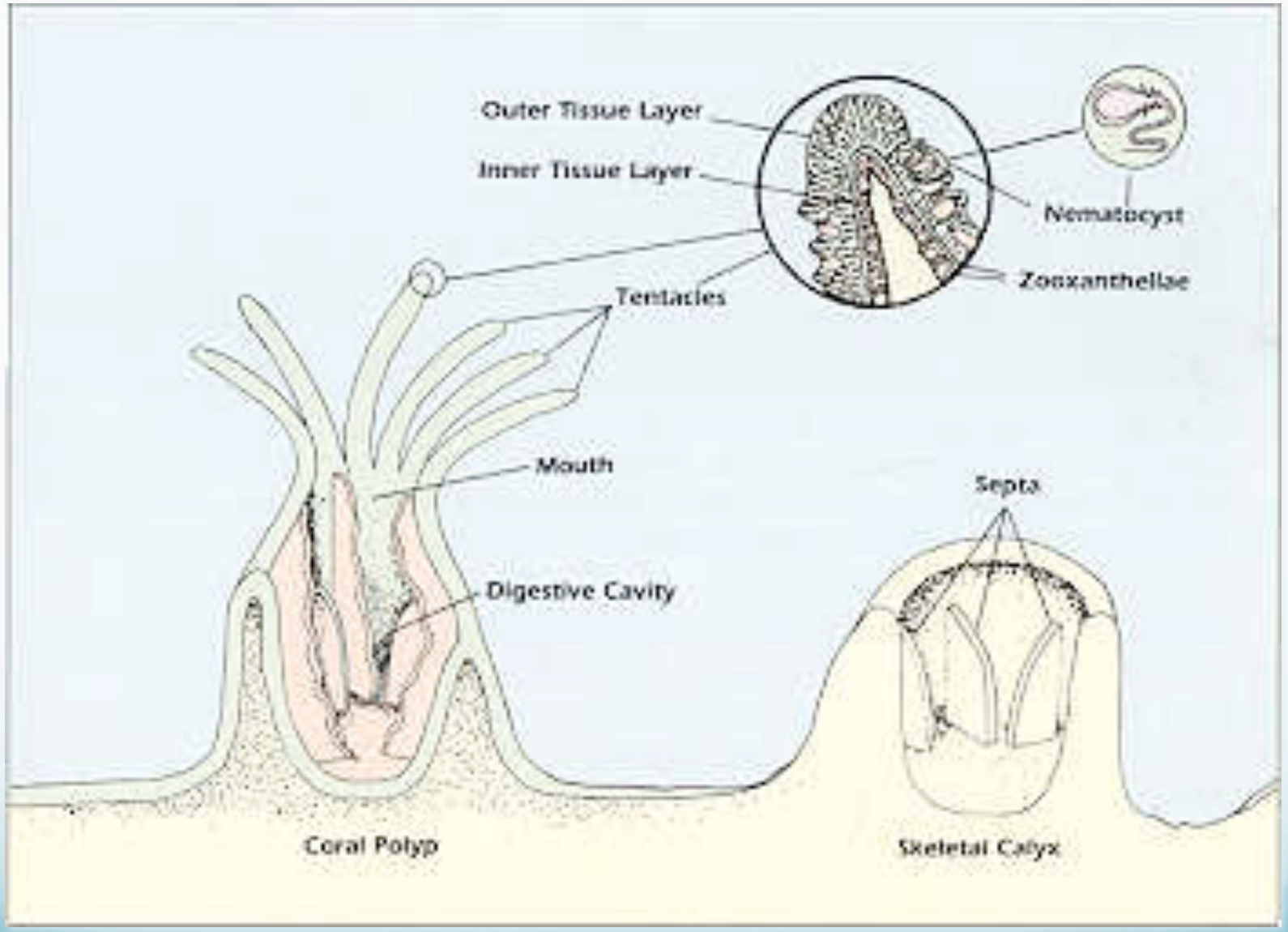
2 types of corals

- 2: Hard Corals
- Polyps secrete calcium carbonate skeleton called a CALYX
- Living organisms grow on top of skeleton
- Eat zooplankton at night
- Algae live inside

Hexacorals



a) coral polyp with expanded arms b) withdrawn polyp c) empty coral cup


Outer Tissue Layer
Inner Tissue Layer
Nematocyst
Zooxanthellae
Tentacles
Mouth
Septa
Digestive Cavity
Coral Polyp
Skeletal Calyx

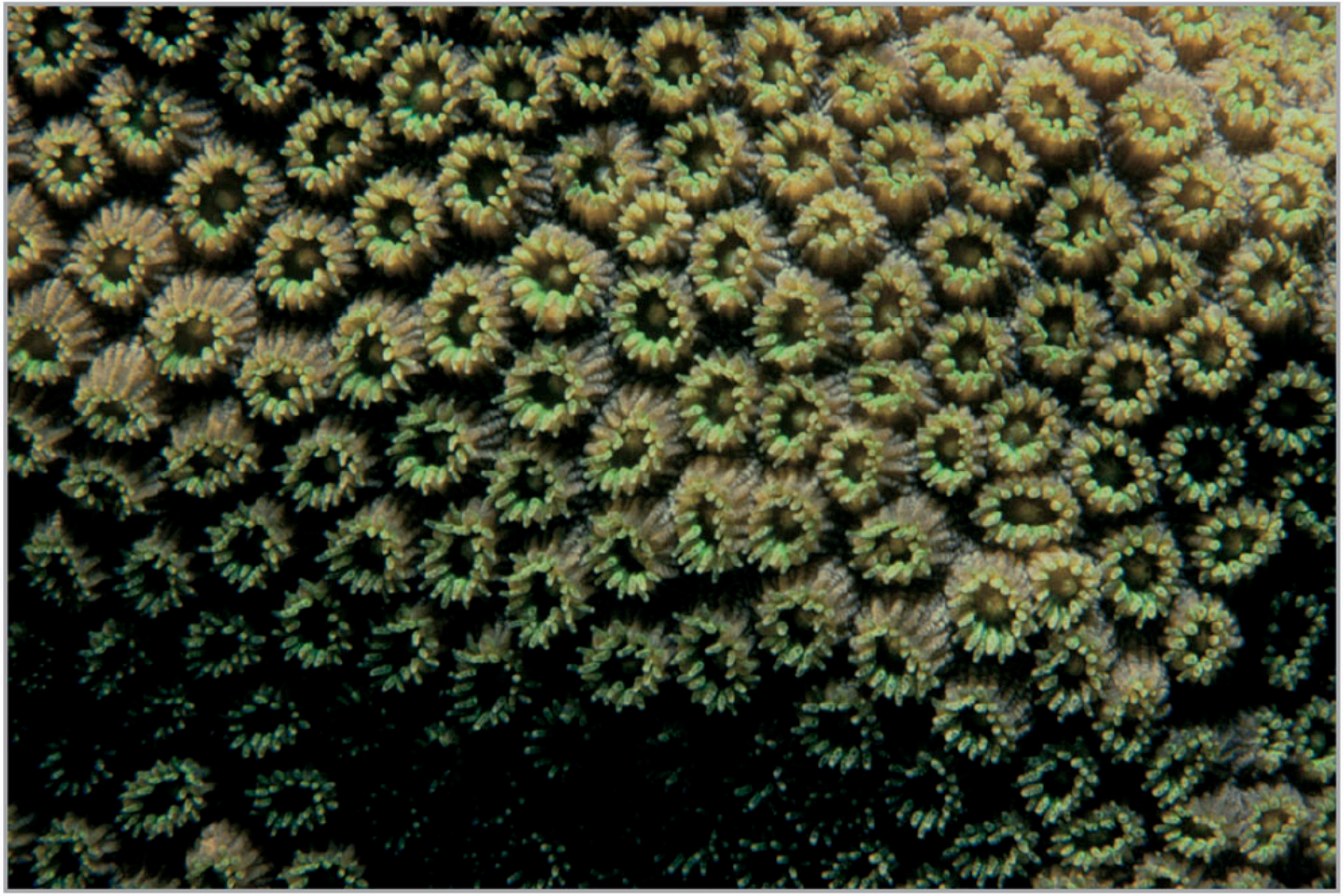
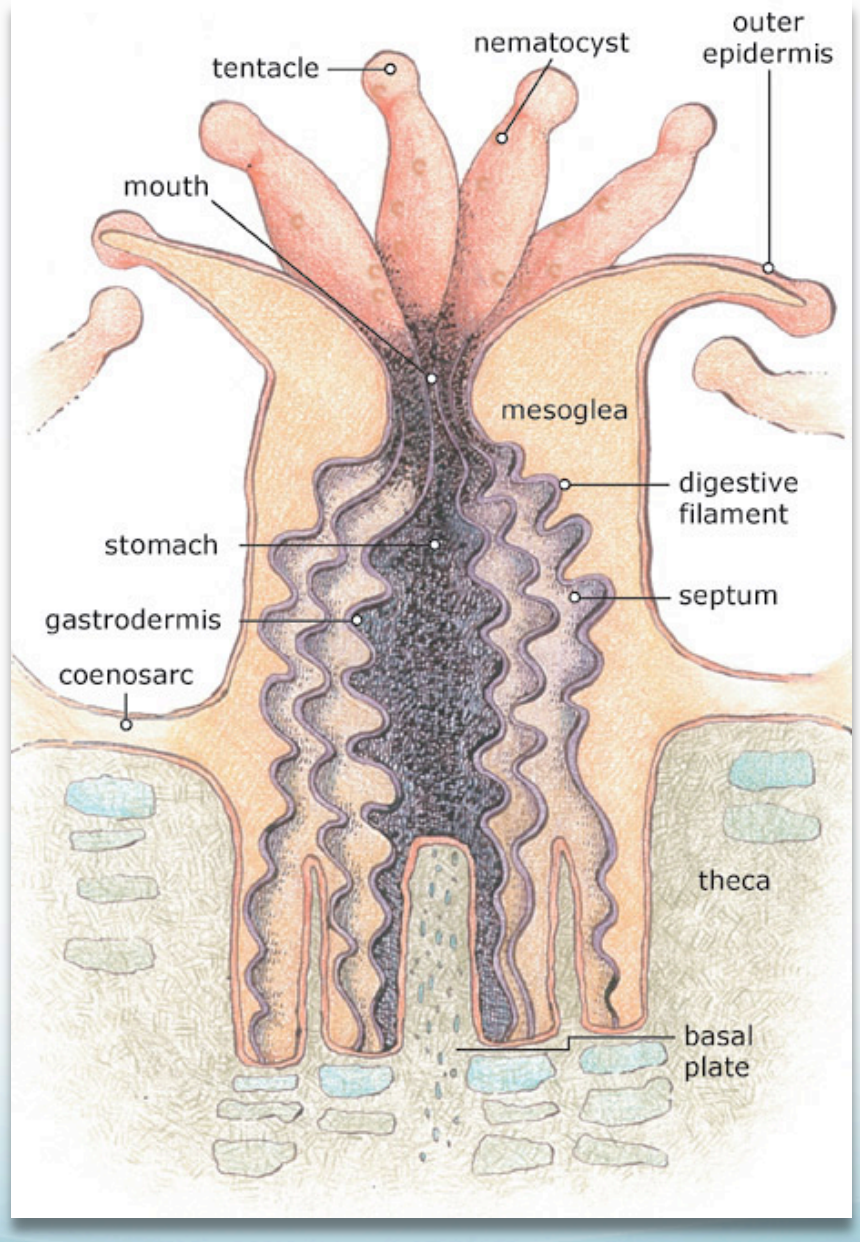
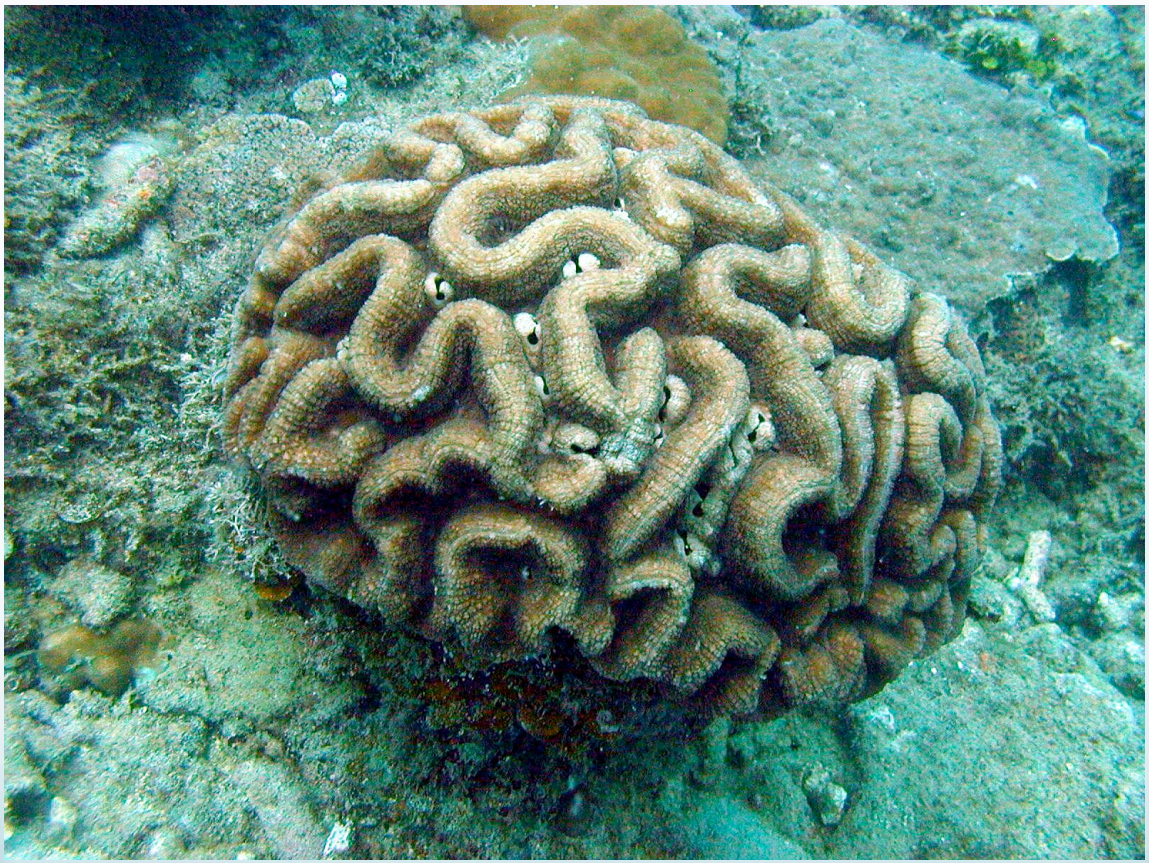


Fig. 8-13b, p.172


tentacle
nematocyst
outer epidermis
mouth
mesoglea
digestive filament
stomach
septum
gastrodermis
coenosarc
theca
basal plate

Hard corals-antler coral

Brain coral



Brain Coral

- massive coral, smaller surface area exposed to light, relies less on algae, more on large individual polyps to get zooplankton
- Eat at night when zooplankton are out, and when they won't be eaten
- Grow slowly, important contributers to reef formation

Elkhorn coral

Elkhorn Coral

- Can be many meters across
- Grows rapidly, 15 cm/year
- Frequently damaged in storms
- Can regenerate a new colony from a broken branch to recover quickly, only a few species of coral can do that!

Plate coral

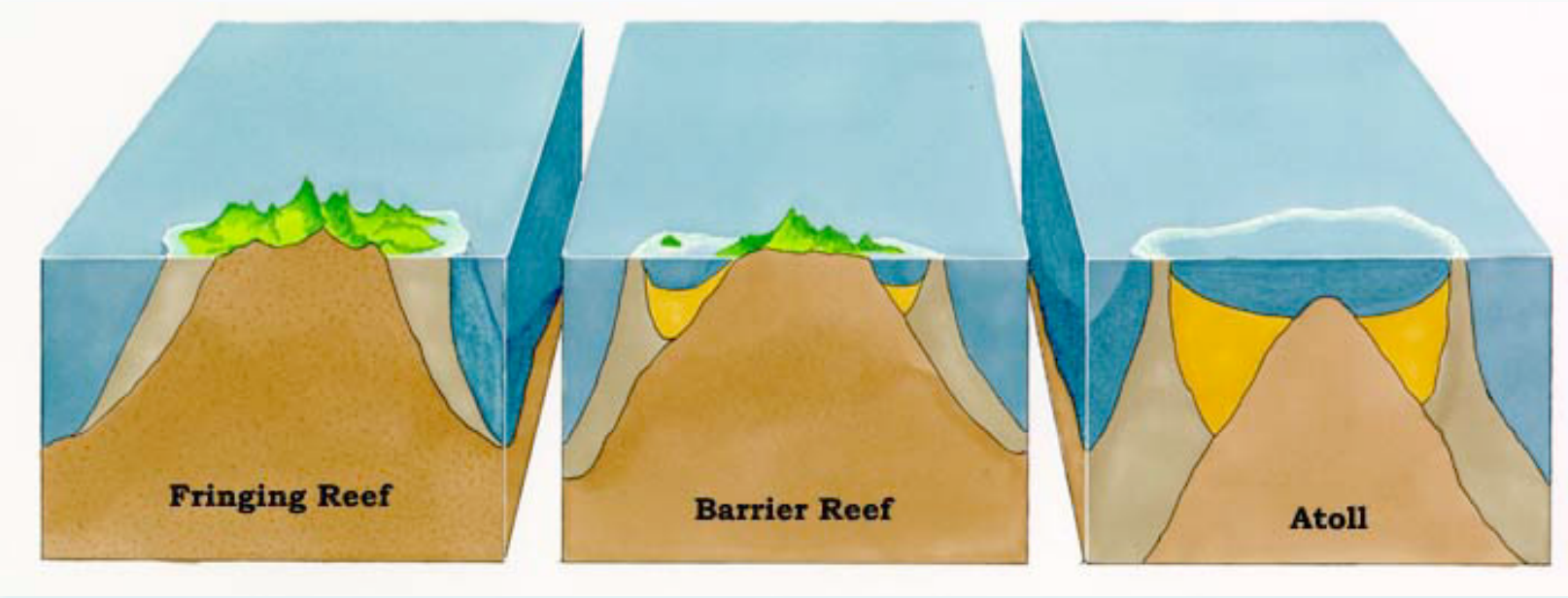
Plate coral

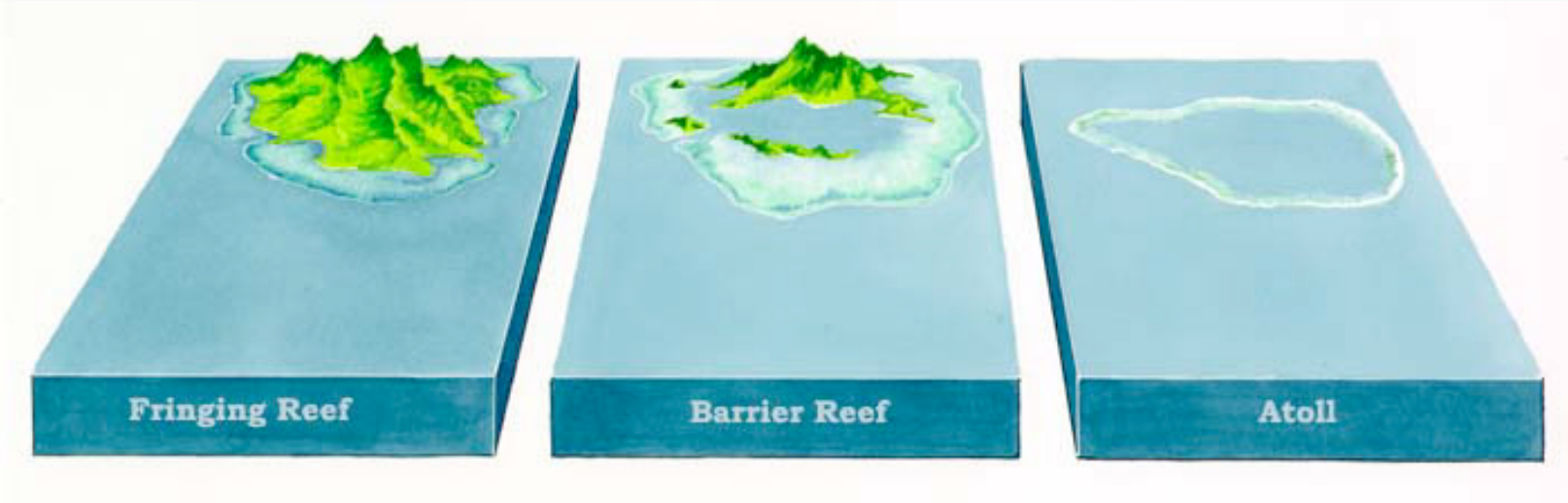
- Found in low light, spreads out flat to maximize exposure to light

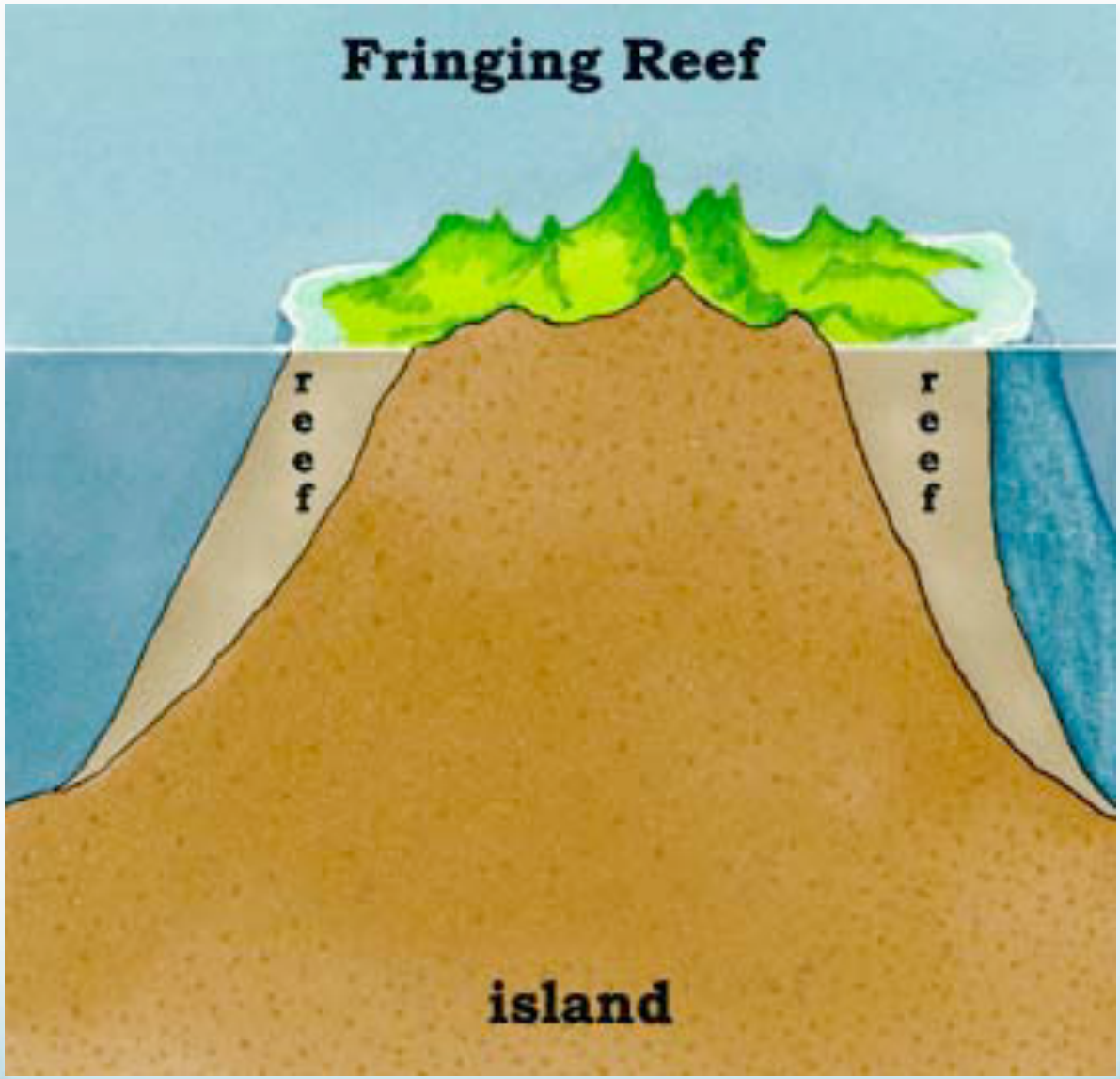
Staghorn coral

Coral Reefs - 3 types

- Fringing Reef
- Barrier Reef
- Atolls

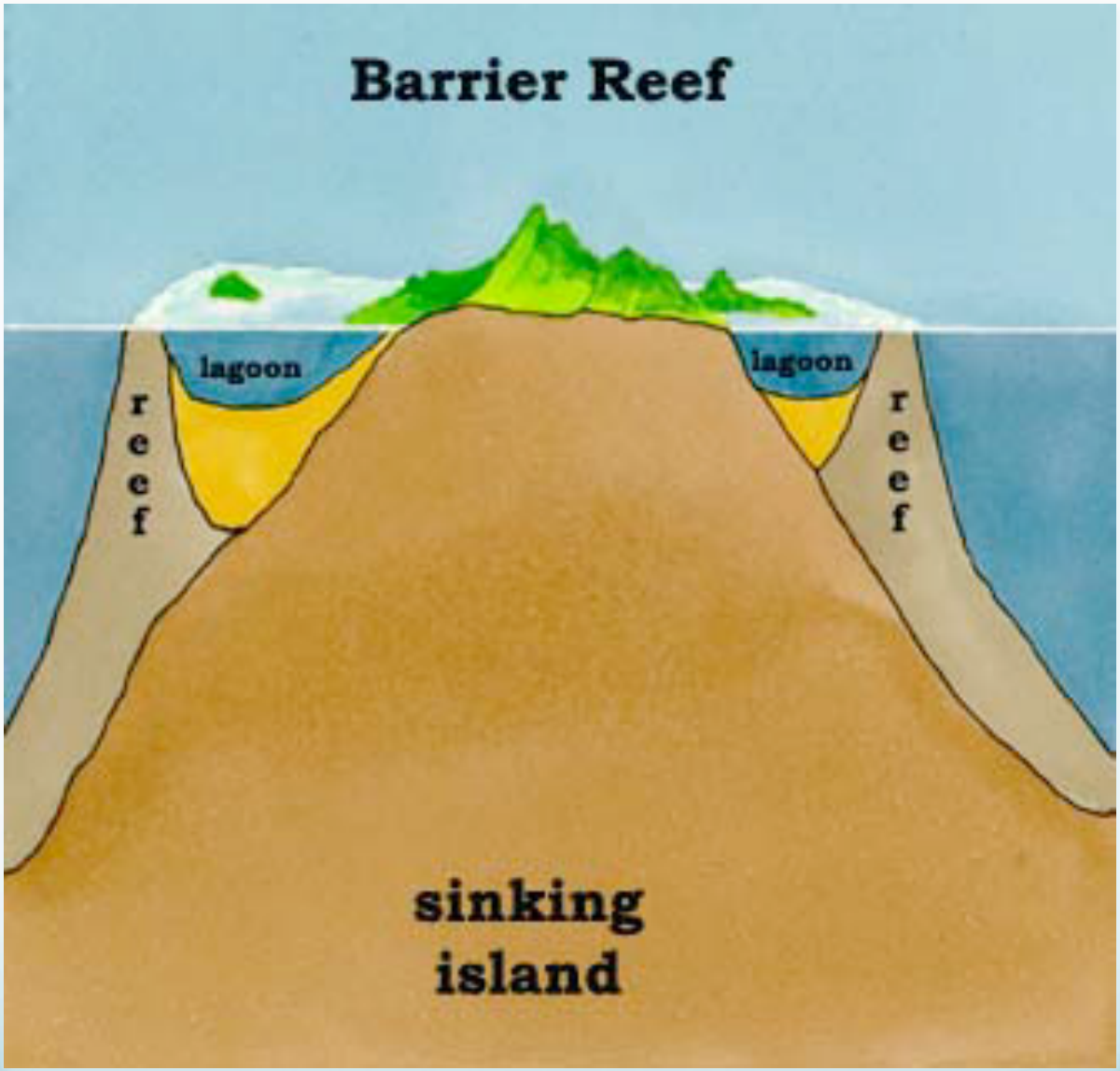

Fringing Reef
Barrier Reef
Atoll


Fringing Reef
Barrier Reef
Atoll


Fringing Reef
reef
reef
island

Fringing Reef

- Grow directly from shore
- In shallows around continents and islands


Barrier Reef
lagoon
lagoon
reef
reef
sinking
island

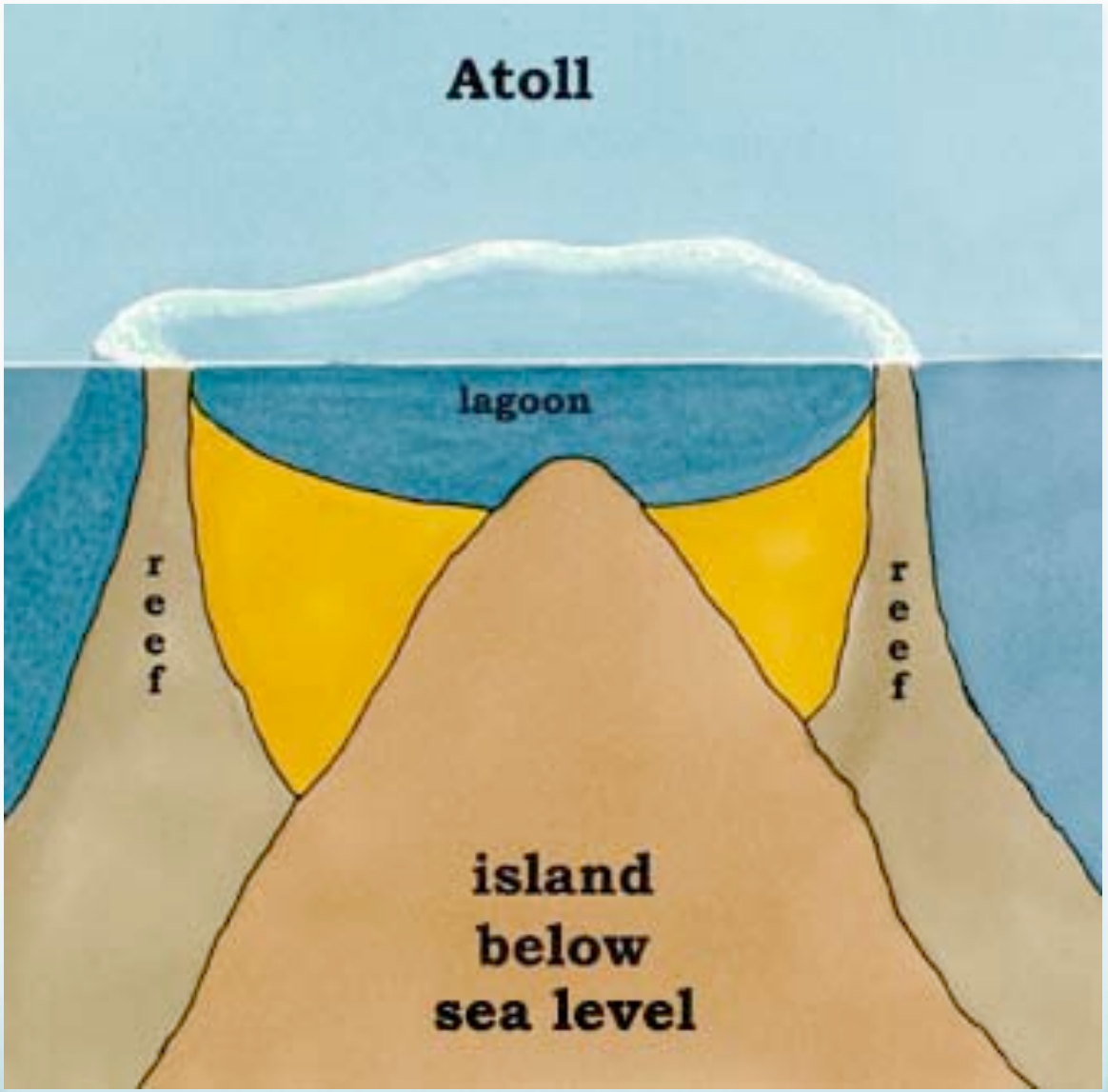
Barrier Reef

- Off shore, lagoon between reef and shore
- Create breakwater to coastal areas


PAPUA NEW GUINEA
Port Moresby
GREAT BARRIER REEF WORLD HERITAGE AREA
Principal Shipping Routes
World Heritage Area boundary
Shipping route
CORAL SEA
Hydrographers Passage
QUEENSLAND
Townsville
Mackay
Rockhampton
Bundaberg
BRISBANE
Tropic of Capricorn
Kilometres
Map No. CG96/98

Great Barrier Reef

- NE Australia
- >1,200 miles long
- 10-200 miles wide


Atoll
lagoon
reef
reef
island
below
sea level

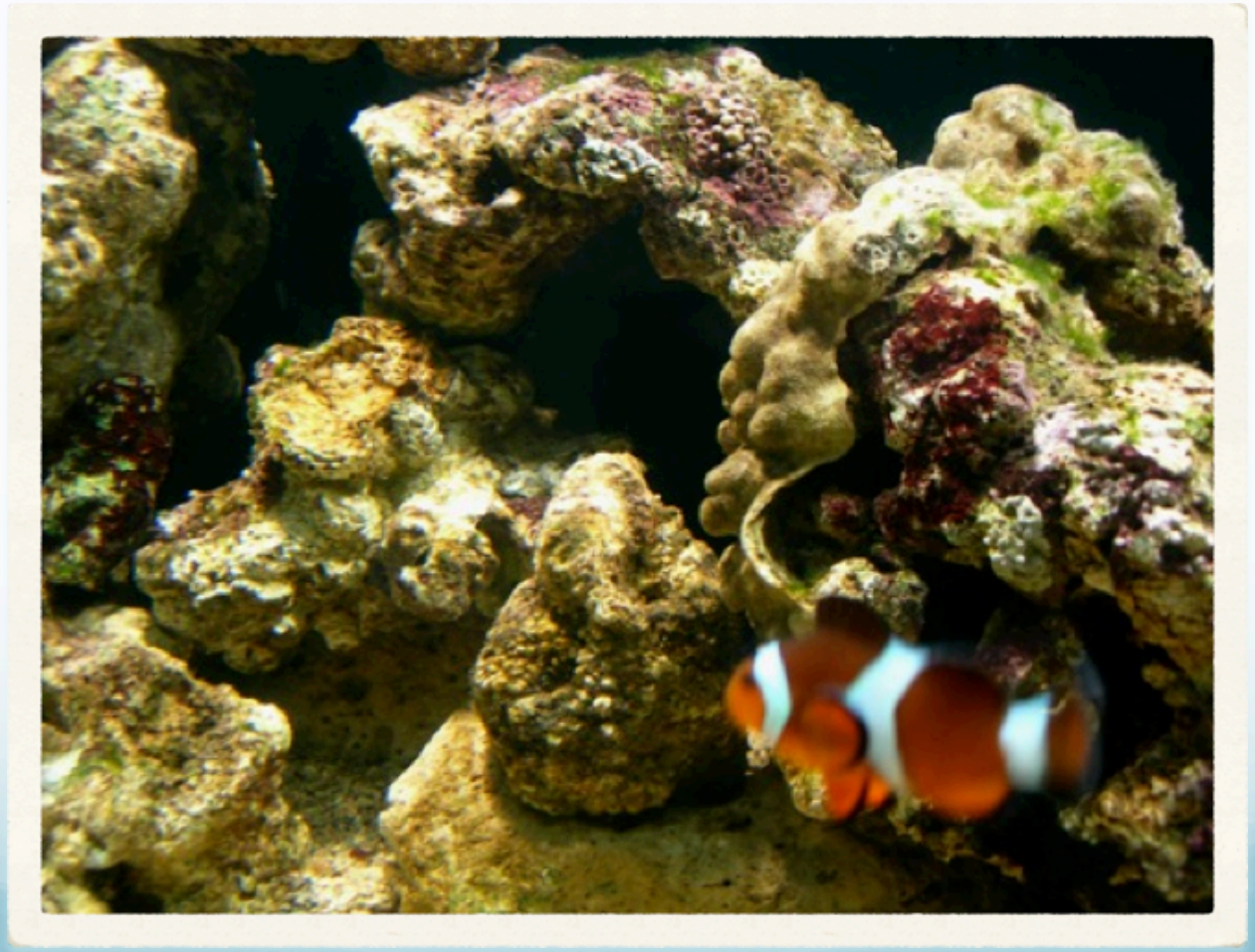
Atolls

- Begin as a fringing reef around a submarine volcano
- Volcano sinks, reef grows
- Only see reef ring or horseshoe

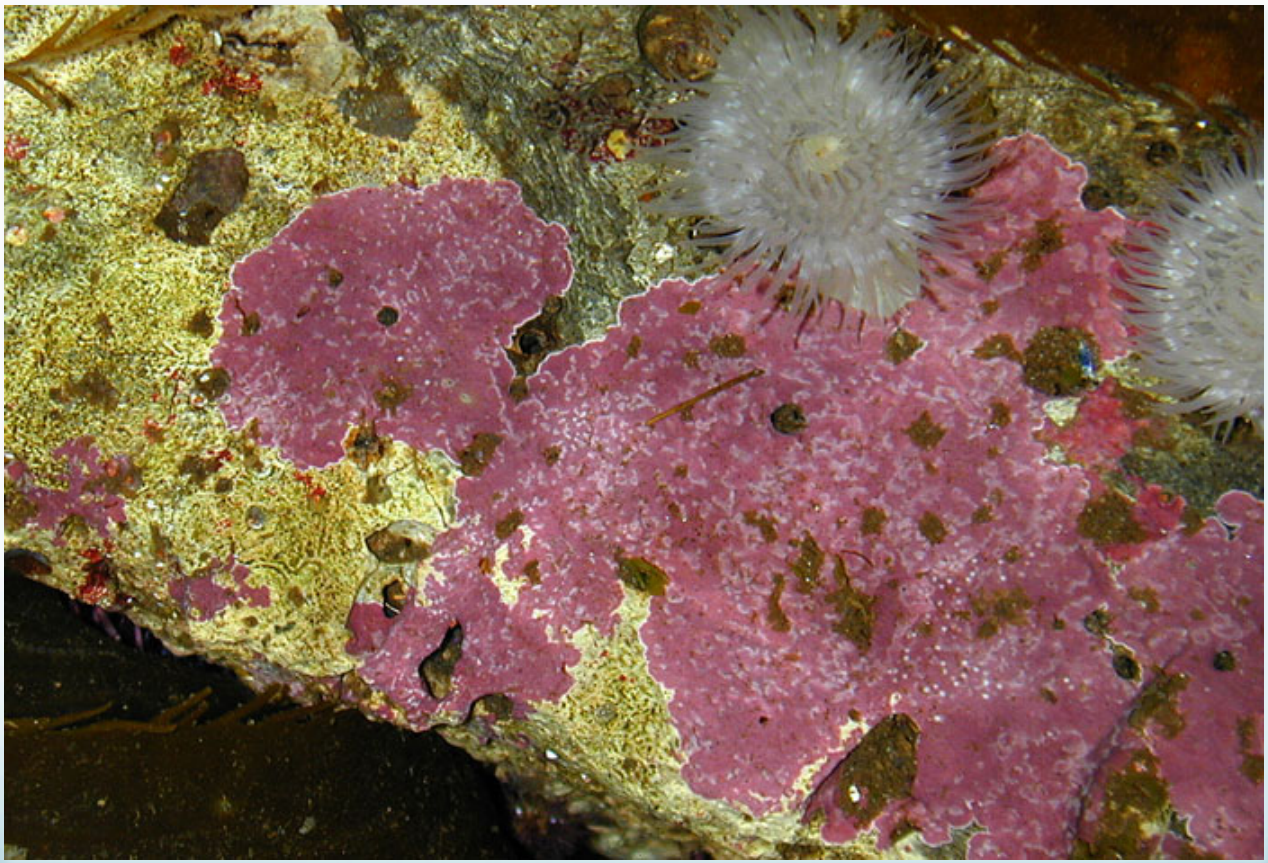
Algae and Sponges

- Coralline algae and sponges
- Produce calcium carbonate and grow with corals
- Help strengthen and hold reefs together

Coralline Algae



Coralline sponges



Zooxanthellae

- Single cell green algae
- Lives in coral tissue, provides food and oxygen
- (likes warm, clear, shallow water for photosynthesis)
- Without algae, corals wouldn't have enough energy to build skeletons

Fig. 8-17a, p.175

Zooxanthellae

How can coral grow in nutrient poor water?

- Zooxanthellae!
- Coral provides nutrients (waste) like phosphorus and nitrogen for algae
- Nutrients are recycled! So coral can grow in nutrient poor areas!

Zooxanthellae

Zooxanthellae

Predators

Nudibranch

Nudibranch

- Sea slug
- Keep stinging cells from prey and use for their own protection to discharge when needed

Bristleworm

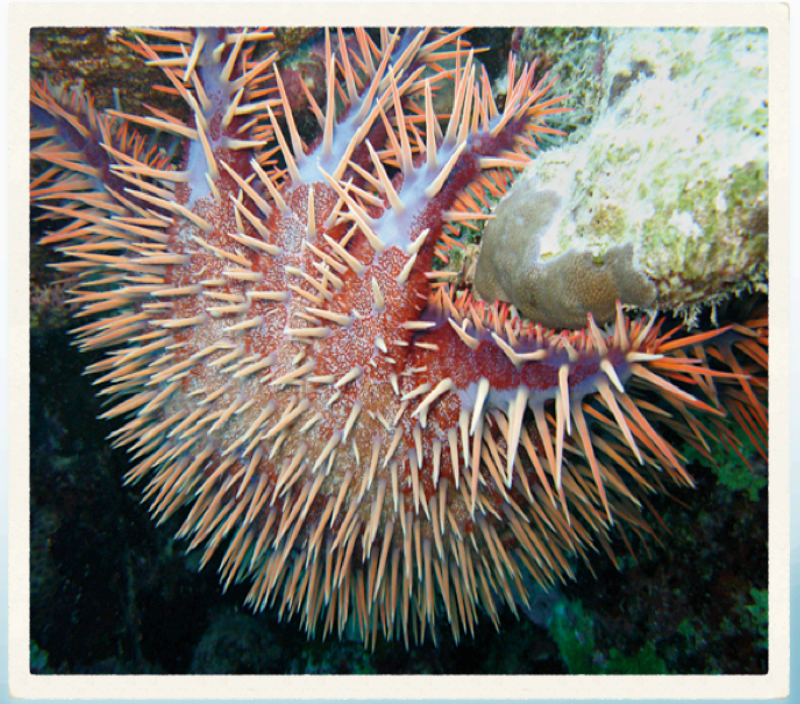
Bristleworm

- Mouth over coral, releases enzymes then absorbs the soup

Crown-of-thorns Starfish

Crown of thorns seastar

- Destroys large patches of coral
- (Pushes out stomach and covers coral and digests it outside of body)



Parrot fish

Parrot fish

- Has beak and grinding structures in digestive tract
- Eats algae and polyps
- Calcium carbonate broken into sand
- keeps brown algae in check (algae growth on reefs can choke them)
- One fish can turn a ton of coral reef into sand in one year!

Parrotfish

Symbiotic Relationships

- Mutualism
- Commensalism
- Parasitism

Symbiosis

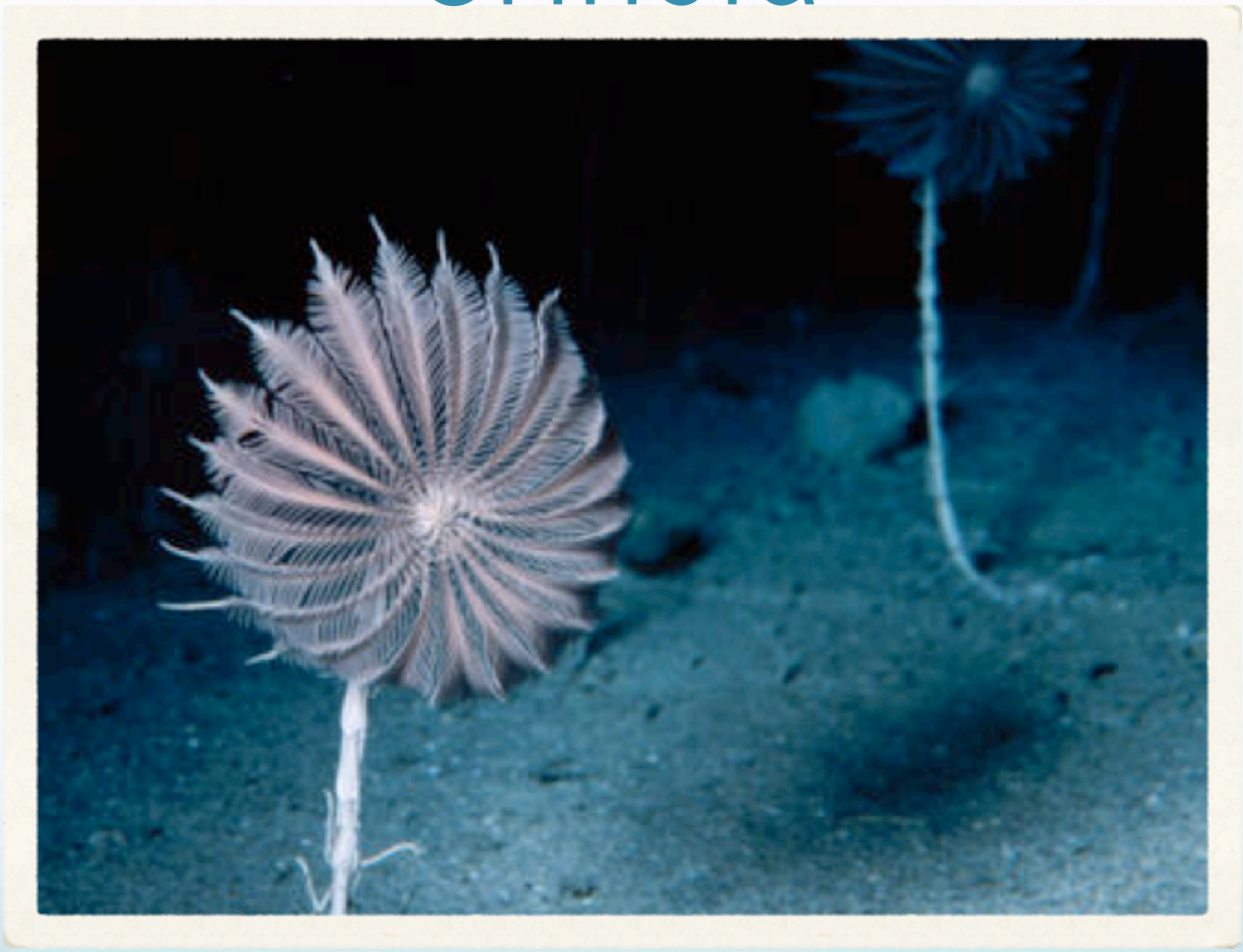
- Mutualism - Both benefit
- Commensalism - one benefits, one doesn't care
- Parasitism - one benefits, one is harmed

Mutualism- cleaner fish

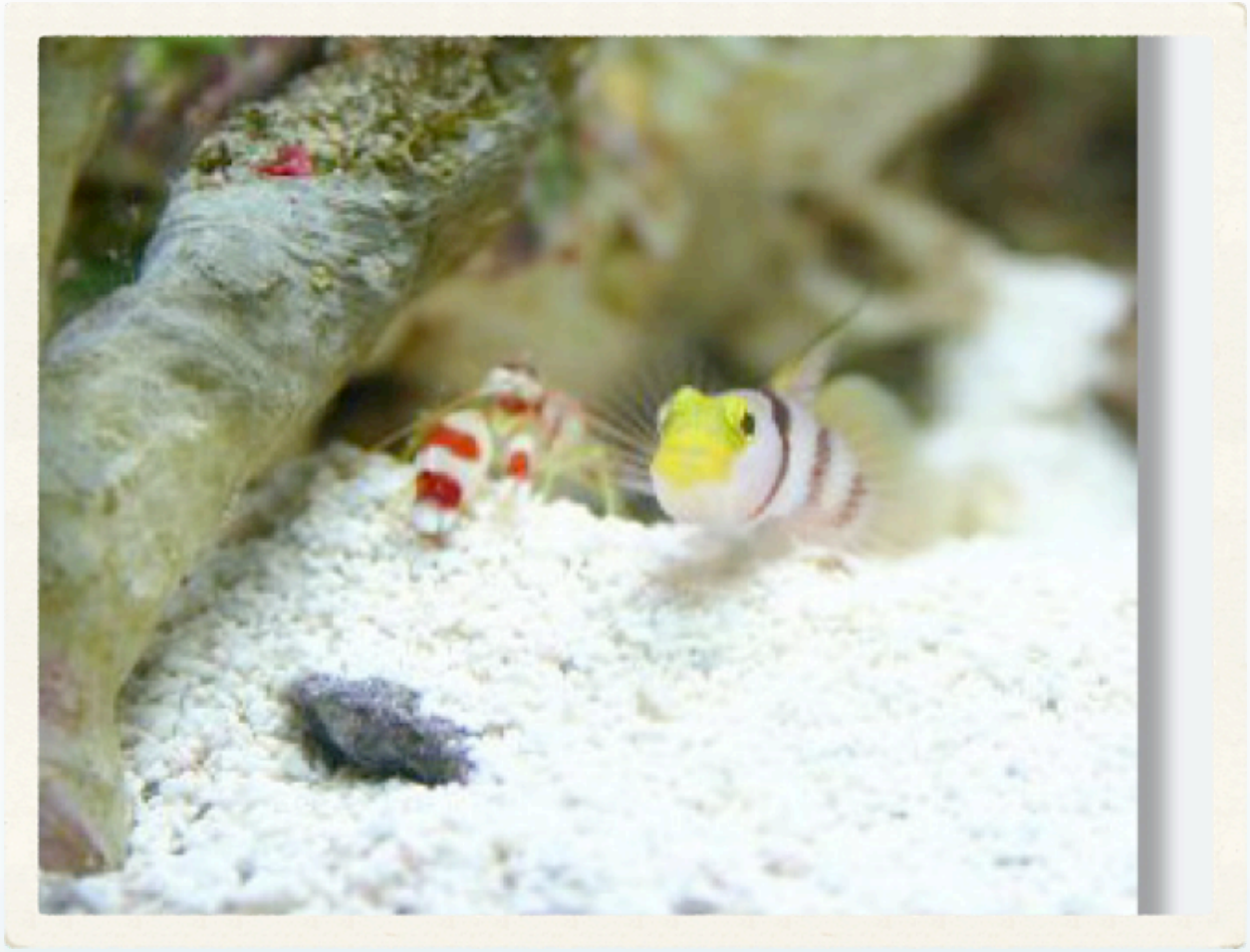
Cleaner wrasse

Giant clam

Crinoid



- Worms and shrimp hang out to get scraps

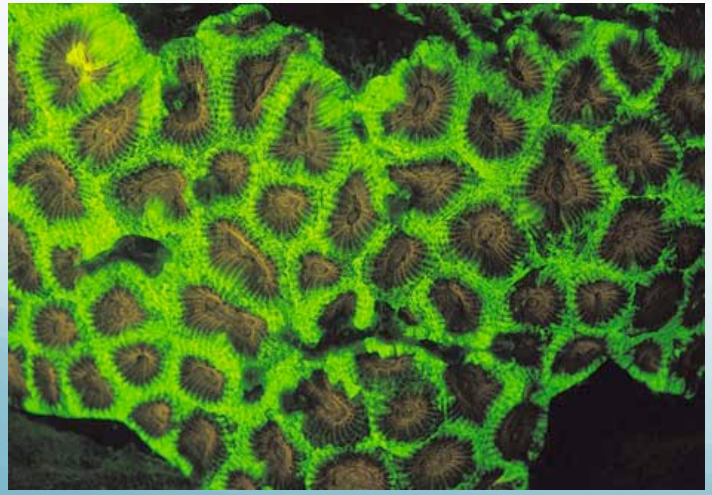


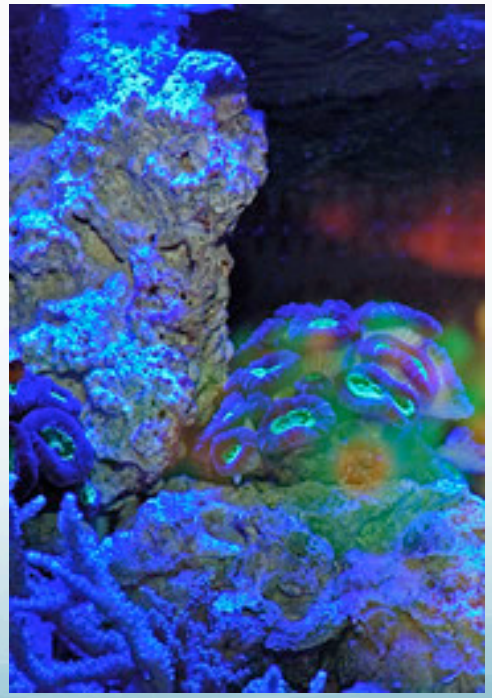
Banded goby and Pistol shrimp

Marine Coral

Hiding in the coral

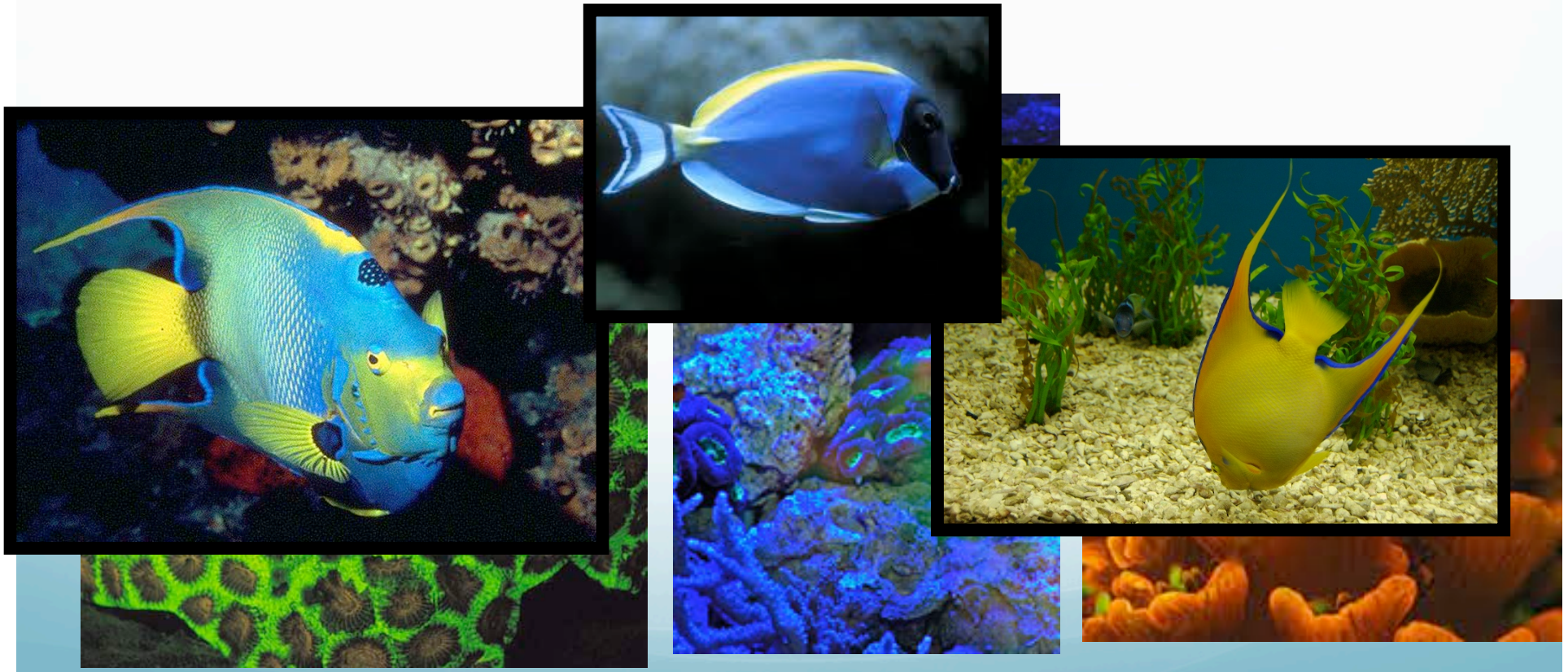
- UV light travels underwater, corals are more colorful than we can see
- Pastels fluoresce brilliant orange, red, and green





Hiding in the coral

- Bright yellow and blues actually are camouflage against corals, fish see differently



Four-eye butterfly fish

Hiding in plain sight

- Excess colors and patterns = nothing stands out
- Contrasting lines makes it difficult for predators to see fine details or outlines
- Spots and lines blur together

Threats to Coral Reefs

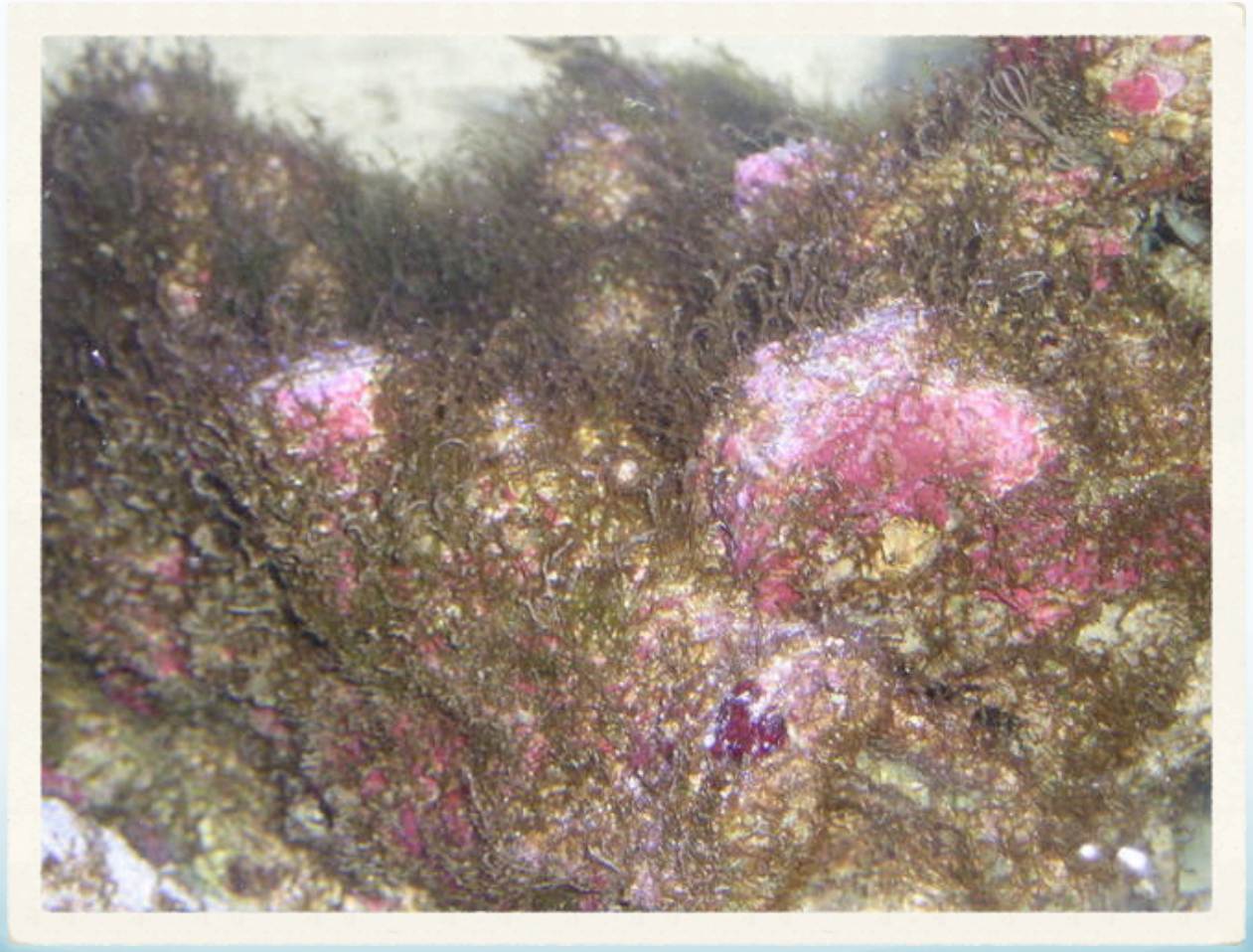
- Sediments from mining, construction
- Collecting corals
- Blast fishing (dynamite)
- Using bleach/cyanide to capture fish for aquariums/ food

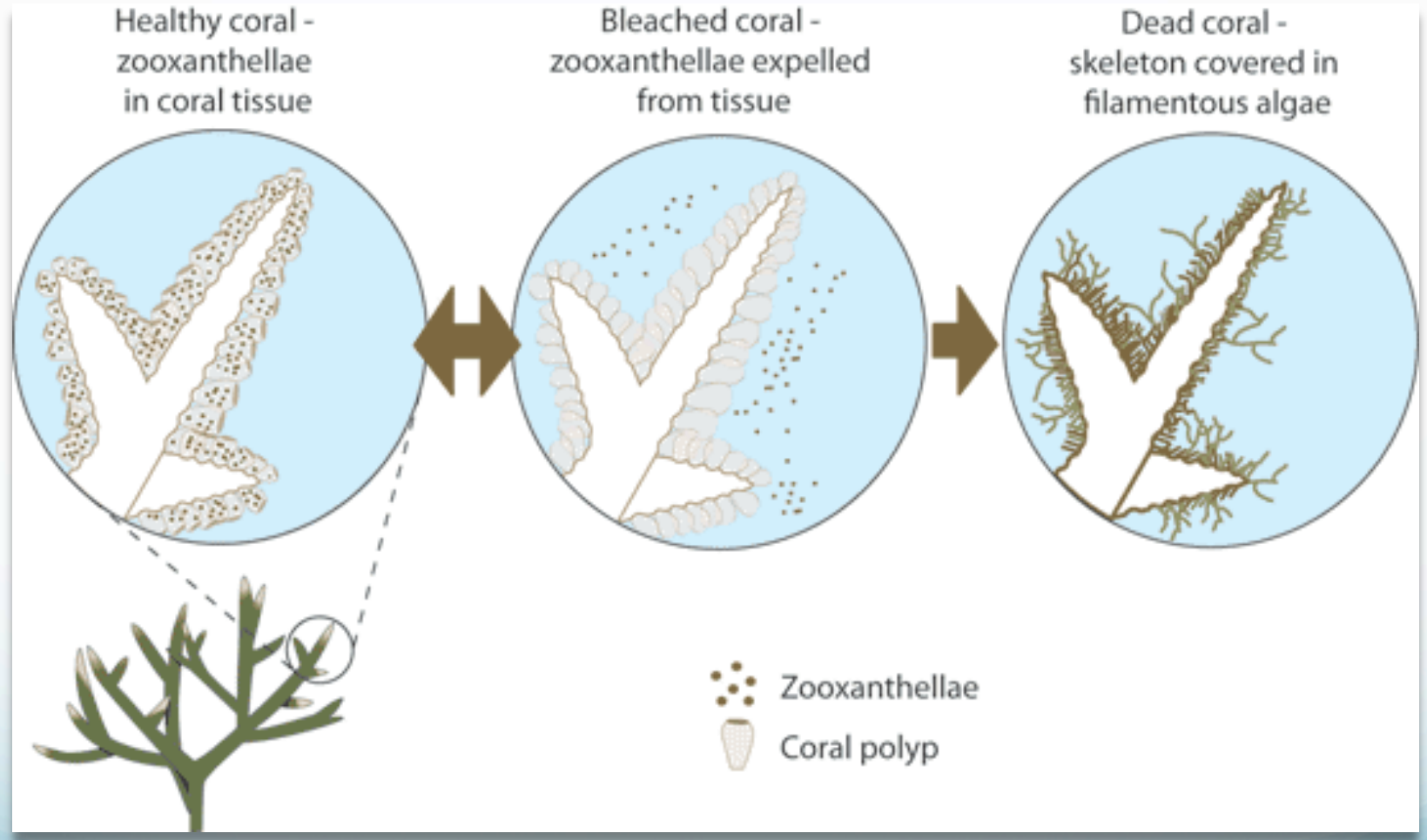
Blast Fishing

Threats to Coral Reefs

- Brown algae smothers coral, increases when there is runoff of fertilizers or waste
- Global warming: increased temperatures cause corals to expel their algae called coral bleaching

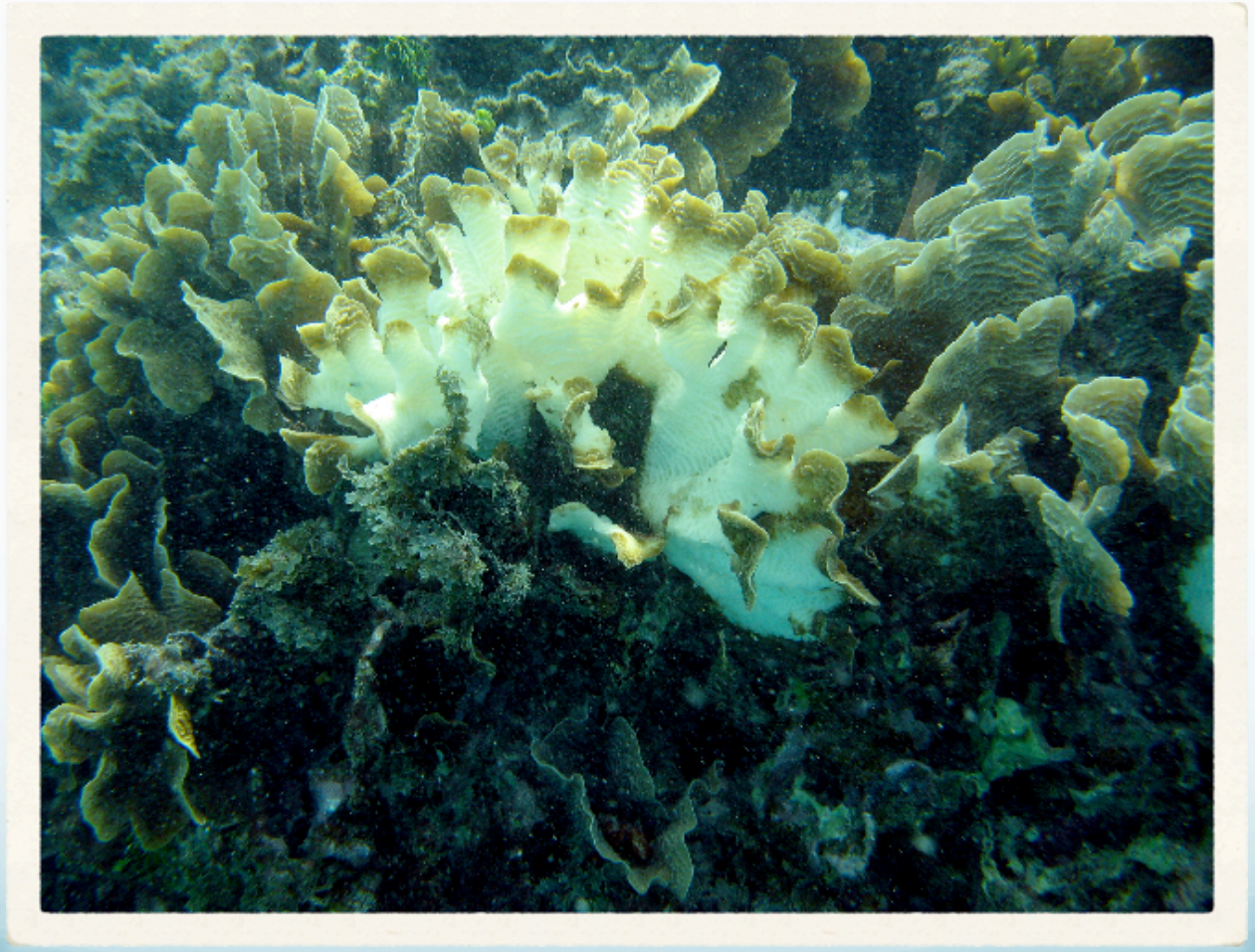
Brown Algae




Healthy coral - zooxanthellae in coral tissue
Bleached coral - zooxanthellae expelled from tissue
Dead coral - skeleton covered in filamentous algae
Zooxanthellae
Coral polyp

Coral bleaching

Coral Bleaching



- Major coral bleaching incidents on the Great Barrier Reef in 1998 and 2002 led to widespread death of corals in some areas.

- NASA 2005-02-28 http://svs.gsfc.nasa.gov/vis/a000000/a003300/a003342/

- Elkhorn and Staghorn coral received federal protection in May of 2006 becoming the first species to be listed under the Endangered Species Act because of vulnerability to global warming. National Marine Fisheries Service passed a rule prohibiting activities that might harm these corals and their habitat.

- Lots of that carbon dioxide also dissolves in the ocean, creating carbonic acid, which can eventually corrode coral and other shell-building animals. Add it all together, and one-third of all coral species are at risk of extinction,

- http://www.npr.org/2011/02/23/133998159/worlds-coral-reefs-facing-serious-threats?sc=17&f=1001

Triggerfish

- nest builders

Damselfish Nestbuilders

Angelfish

- Defend territories, if dominant male killed, dominant female becomes the dominant male