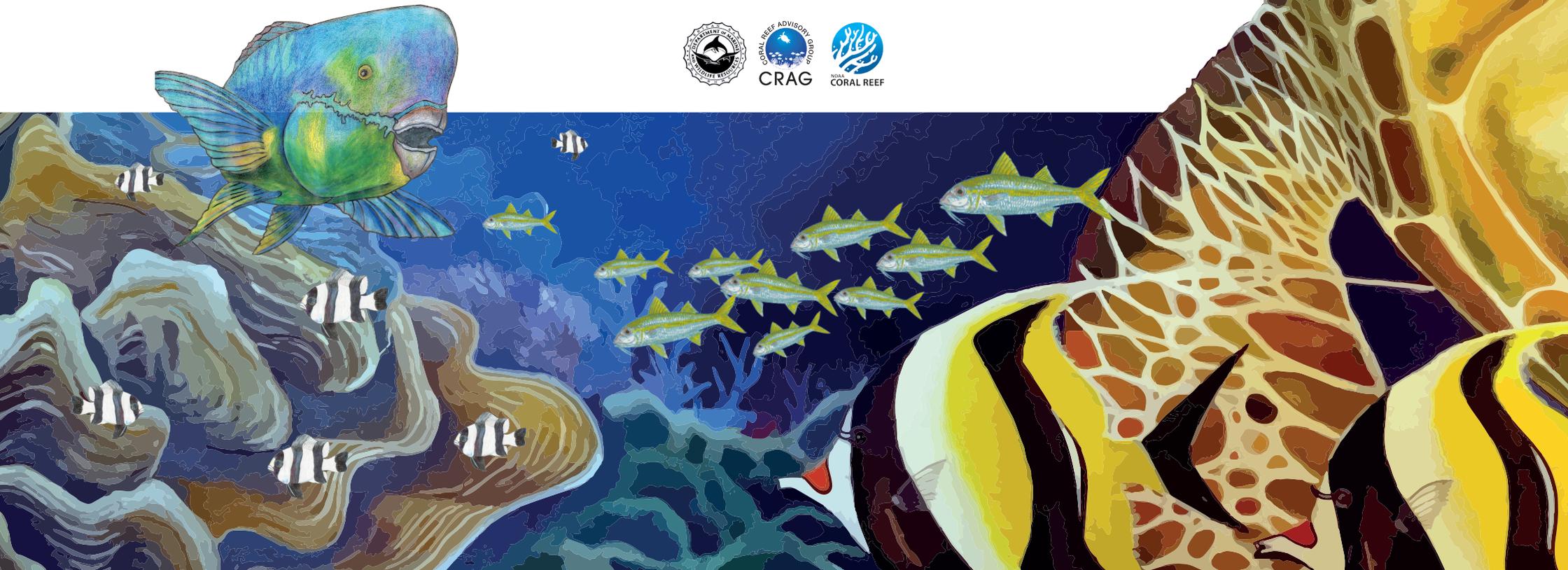
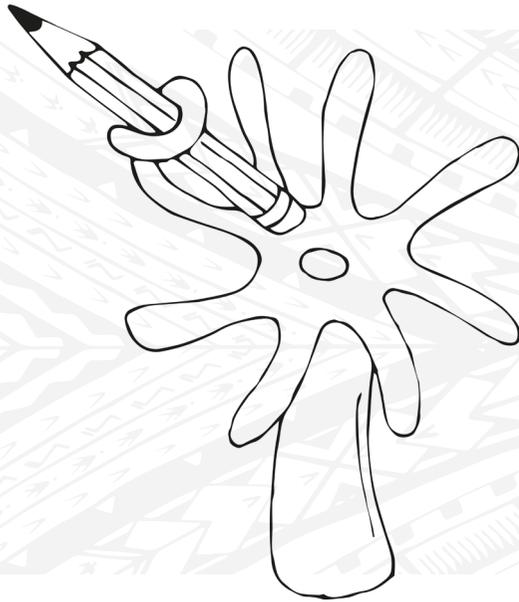


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CORAL REEF

FACTS & ACTIVITIES





Grade 7 - 12

This Coral Reef booklet is designed for middle and high school students. This booklet provides opportunities for students to develop an understanding and appreciation of the importance of healthy coral reefs in the territory. This book will also help to achieve some of the objectives stated in the American Samoa Science Standards and Benchmarks.

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CORAL REEF FUN FACTS

DID YOU KNOW ?

Coral Reefs:

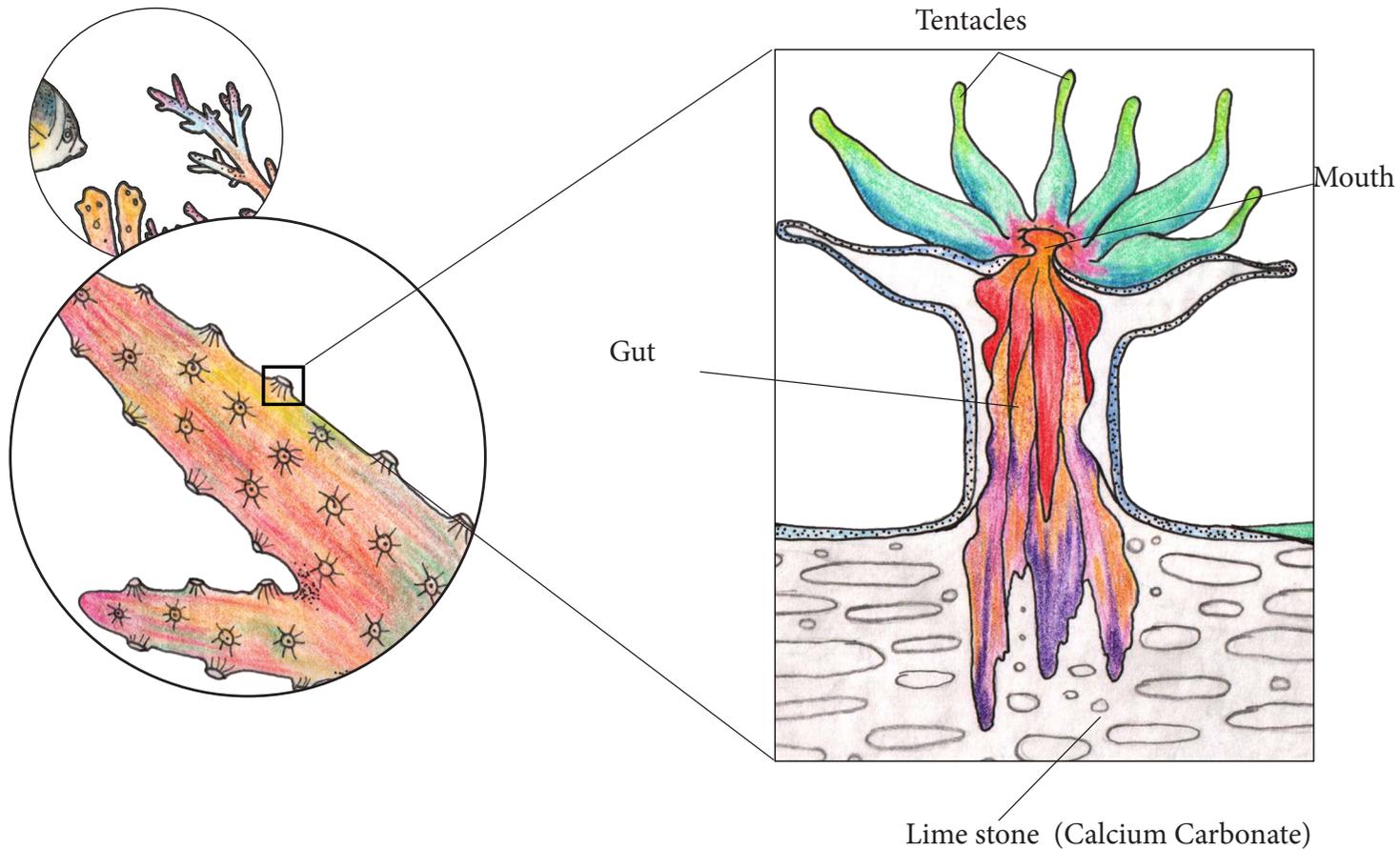
- are one of the most complex and colorful tropical ecosystems in the world.
- are generally found in warm waters.
- build massive & complex physical structures that can be seen from space.
- have high economic value (fishing, tourism, etc)
- help to protect coastal erosion
- can provide medicinal benefits, for example an enzyme produced by coral is used in human medicine to treat asthma and other inflammatory disorders.
- provide food and shelter for thousands of species of reef fishes and other marine animals.
- healthy reefs = healthy population



WHAT IS A CORAL?

Is it a plant, an animal or a rock? Actually, coral is a tiny, fragile, spineless ANIMAL. The basic unit of the body of a coral is called a POLYP, which is a hollow bag-like animal filled with sea water, with finger-like structures called tentacles arranged in a circle on the top. In the center of the ring of tentacles is a mouth. Coral polyps generally live in large colonies in rock-like calcium carbonate structures that they build from materials that they extract from the surrounding water.

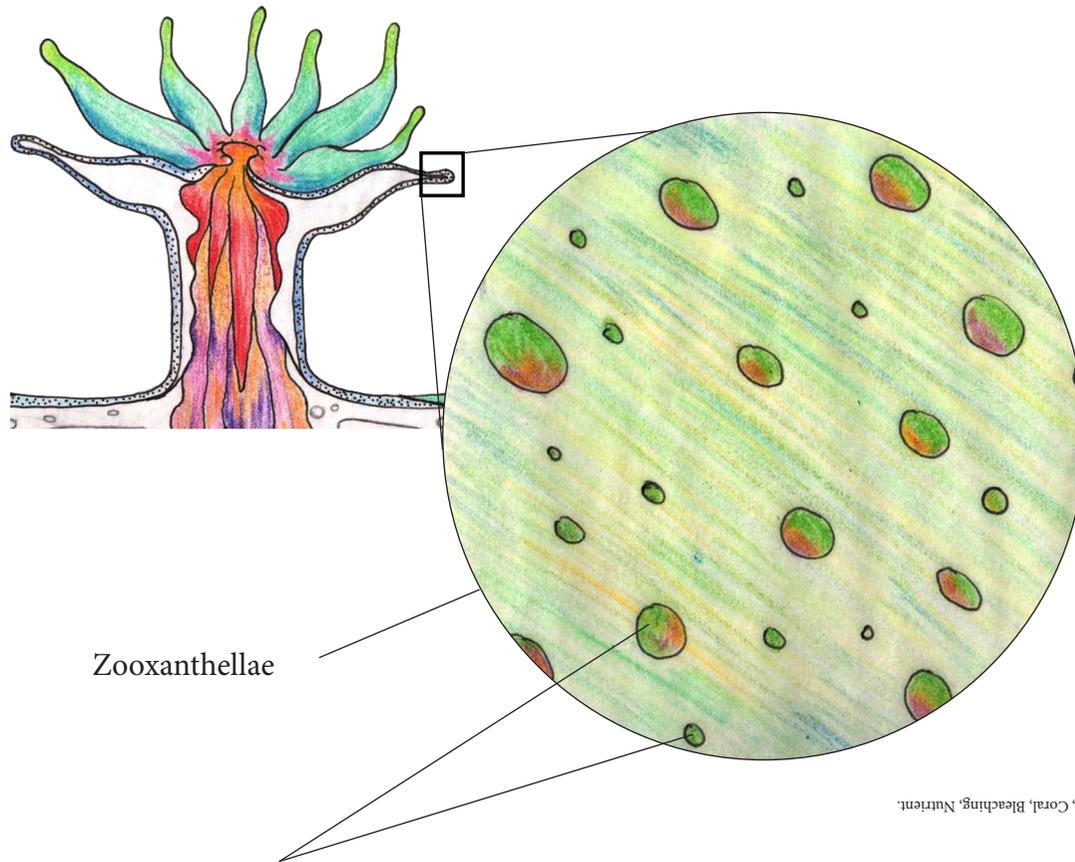
CORAL POLYP ANATOMY



ZOOXANTHELLAE & POLYP RELATIONSHIP

What is a zooxanthellae?

- Single-celled microscopic organisms also called dinoflagellates that live in the coral polyp.
- They use sunlight to make food for the coral polyps, just like plants on land do.
- They produce vibrant pigments that are visible through the clear coral tissue giving corals most of their color.



Zooxanthellae

Chloroplast

The functional organ where photosynthesis primarily occurs.

Mutualism relationship between the coral and the Zooxanthellae

Zooxanthellae use the sunlight to make food for the polyp through the process of photosynthesis and in return the polyp provides shelter for the algae.

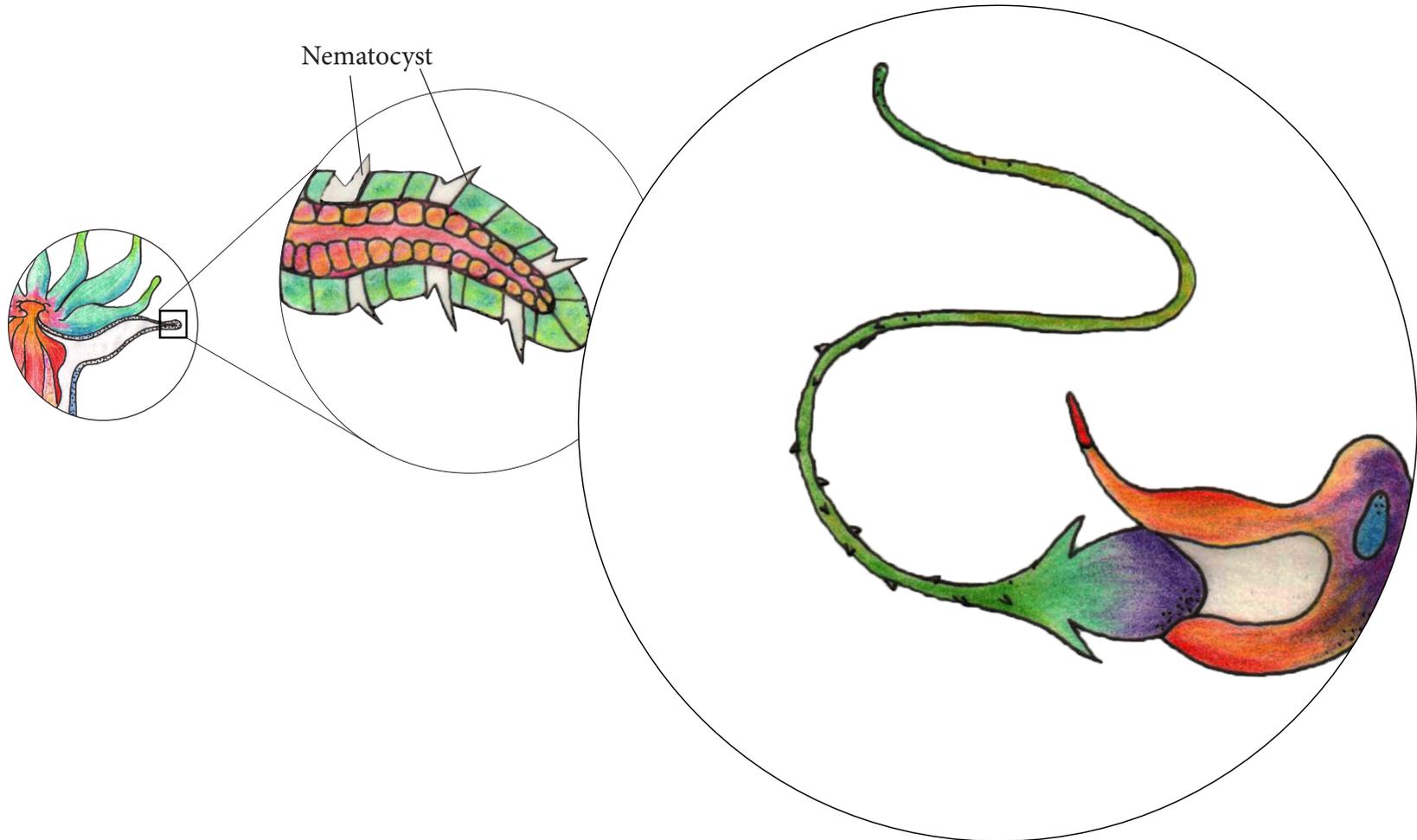
ACTIVITY #01: Scrabble the words below

1. kanoltnp
2. ounlploti
3. free
4. tneicunsg
5. voer-fisignh
6. oplyp
7. epaemrttuer
8. isrbde
9. ynmtoascte
10. OC2
11. oaxheoeallznt
12. symcsteeo
13. rcoal
14. ingcehlbia
15. inertnut

Plankton, Pollution, Reef, Encrusting, Over-Fishing, Polyp, Temperature, Debris, Nematocyst, Zooxanthellae, Ecosystem, Coral, Bleaching, Nutrient.

NEMATOCYST

Some corals use stinging cells called nematocysts to capture their food. These cells are located in the coral polyps' tentacles and outer tissues. If you've ever been "stung" by a jellyfish, you've encountered nematocysts.



All Cnidarians have nematocysts as a specialized organelle. Cnidarians use their nematocysts to capture prey and as a defense mechanism against predators.

The diagrams on the right show the anatomy of a nematocyst cell and its “firing” sequence.

Figure 1. is a nematocyst inside its cellular capsule. The cell’s thread is coiled under pressure and wrapped around a stinging barb. When potential prey makes contact with the tentacles of a polyp, the nematocyst cell is stimulated. This causes a flap of tissue covering the nematocyst—the operculum—to fly open.

Figure 2 is an image showing an open operculum, the rapidly uncoiling thread and the emerging barb. The barbs at the end of the nematocyst are designed to stick into the polyp’s victim and inject a poisonous liquid. When subdued, the polyp’s tentacles move the prey toward its mouth and the nematocysts recoil back into their capsules.

Cross section of a polyp’s tentacle

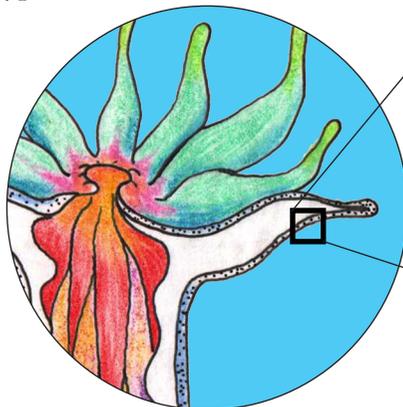
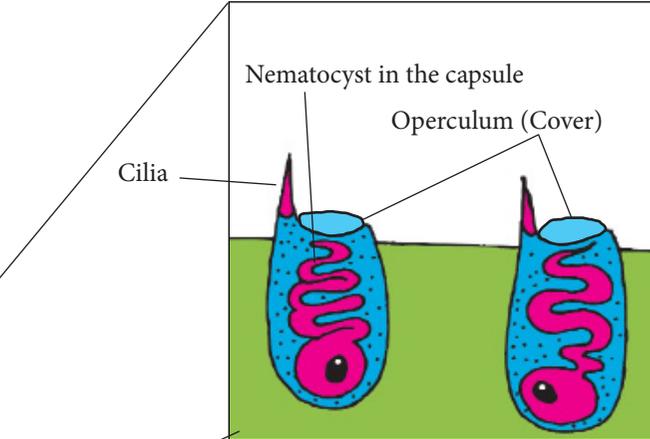
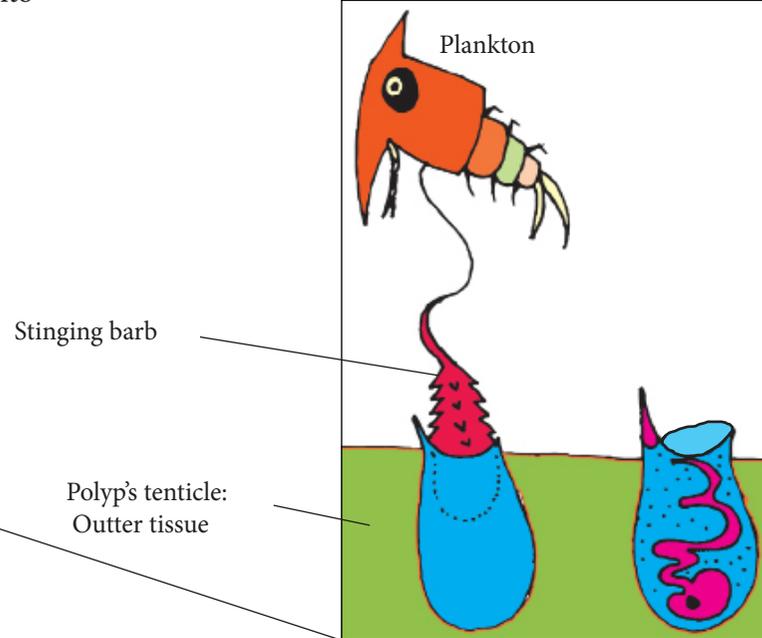


Figure: 1



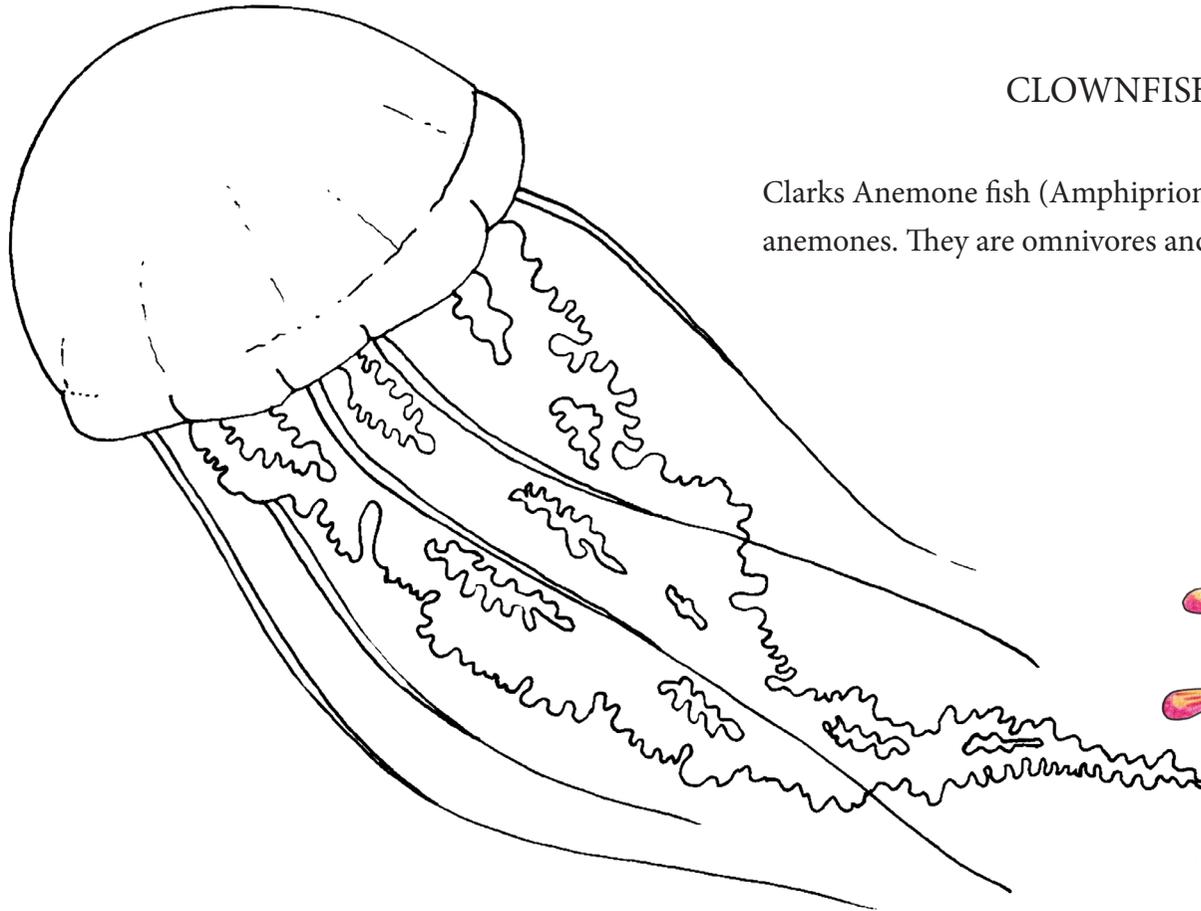
Polyp’s tentacle:
Outer tissue

Figure: 2



COLOR YOUR OWN JELLYFISH

Corals are predators just like anemones and jellyfish. They have stingers on their tentacles that can stun small organisms, which are then moved to the mouth and digested.



CLOWNFISH INSIDE AN ANEMONE

Clarks Anemone fish (*Amphiprion clarkii*) have a symbiotic relationship with anemones. They are omnivores and grow to 14cm.



CORALS ARE UNIQUE ANIMAL

Corals are unique animals because they are modular, meaning they are made up of thousands of polyps, each connected to one another. Hence, corals are also referred to as “coral colonies”.

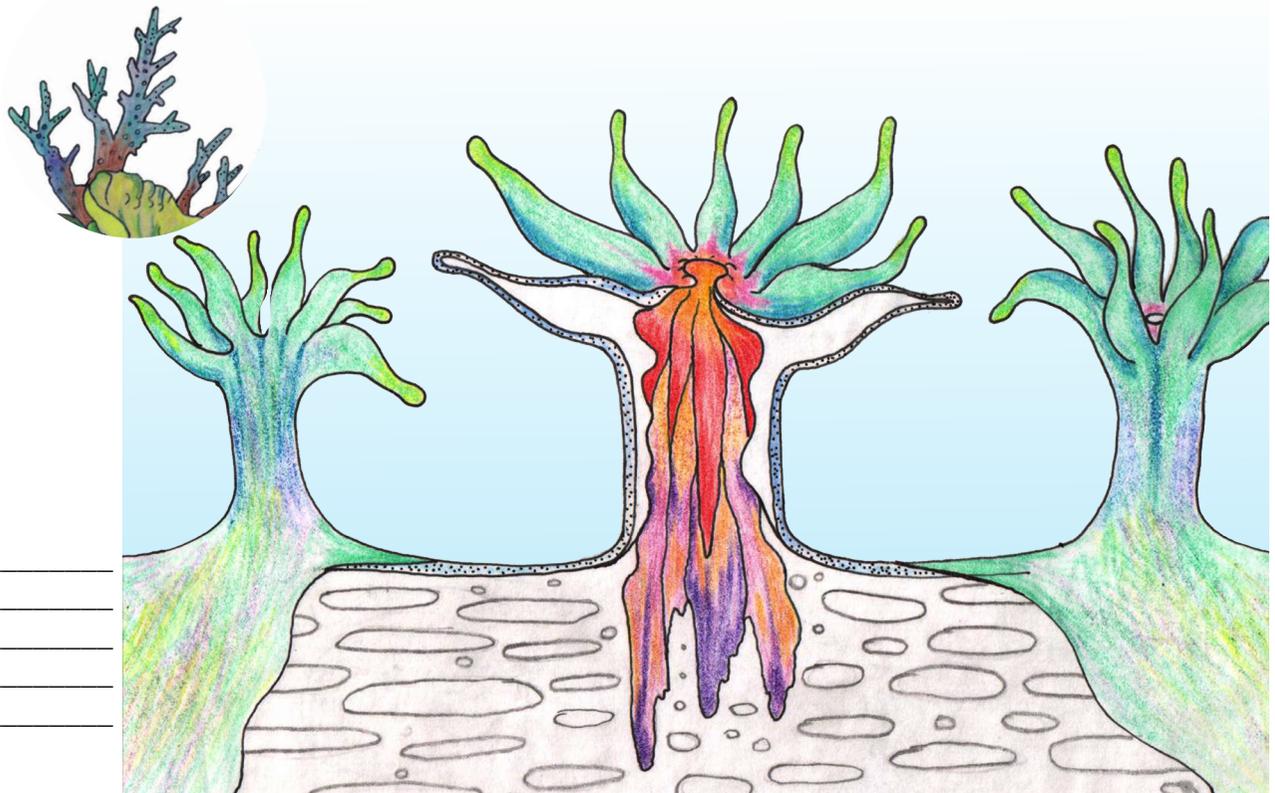
The shape of the colony tends to be based on three factors: Wave Action, Light Level and Genetics. The forms of many coral colonies are pre-programmed genetically and then acted upon and shaped by physical factors, such as those created by waves and sunlight.

What conditions do coral reefs require to stay healthy?

- Light
- Low nutrient, clear water
- Salinity 32 -42 ppm
- Water temperature 50°F - 84°F
- Water circulation

QUESTION:

What does water circulation mean?

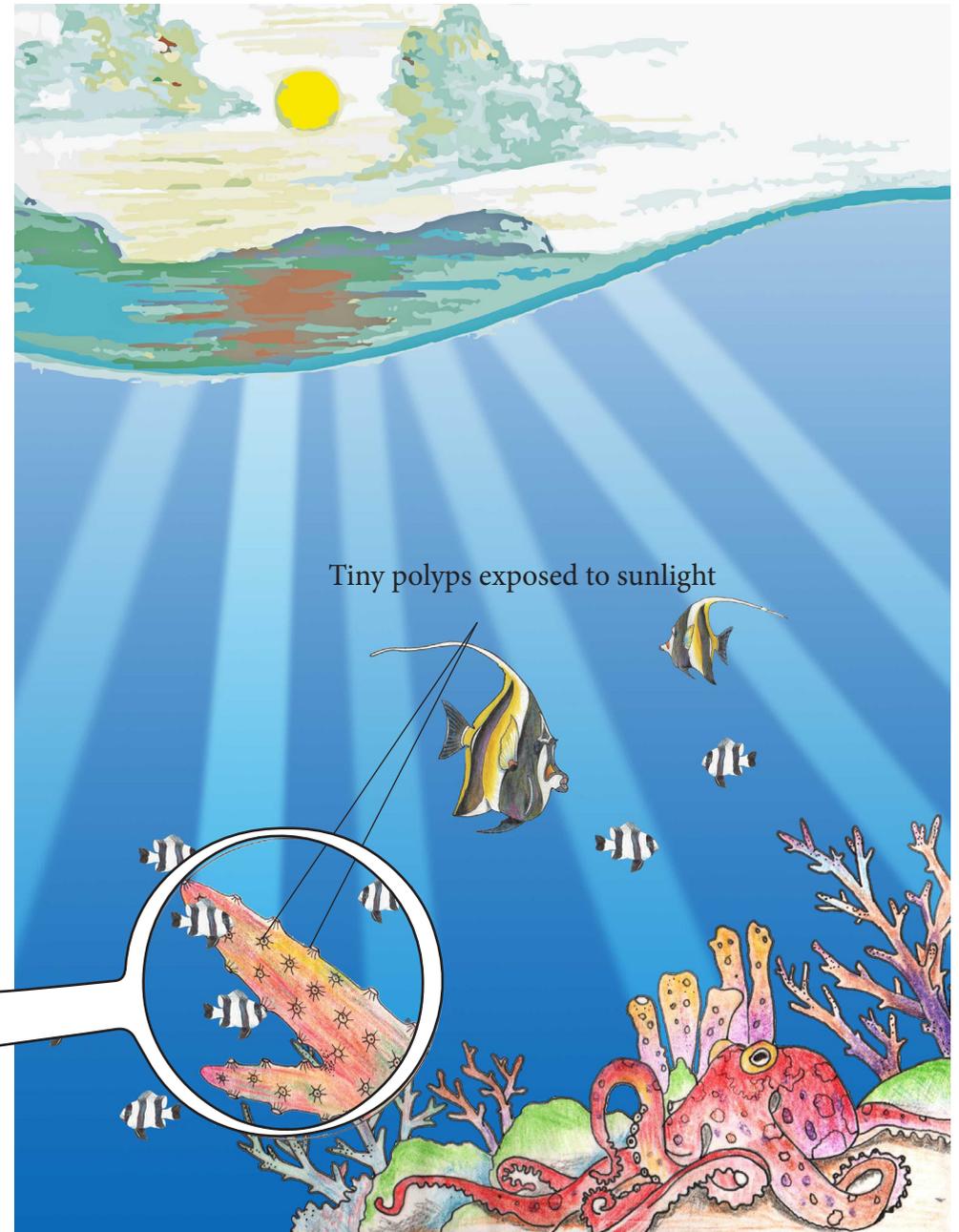


DAY TIME FEEDING

During the day time corals receive most of their nourishment from tiny single-celled algae (zooxanthellae) that live in the polyp tissues. These algae use the sunlight to make food through the process of photosynthesis, just like plants do.

Corals generally grow very slowly, about 1 to 2 inches per year. They can grow at different rates depending on the sunlight, temperature (18°C - 29°C is ideal), water clarity, salinity and availability of food.

QUESTION: What do you think will happen to the corals when there is a cloud of suspended particles (sediments) in the water column?



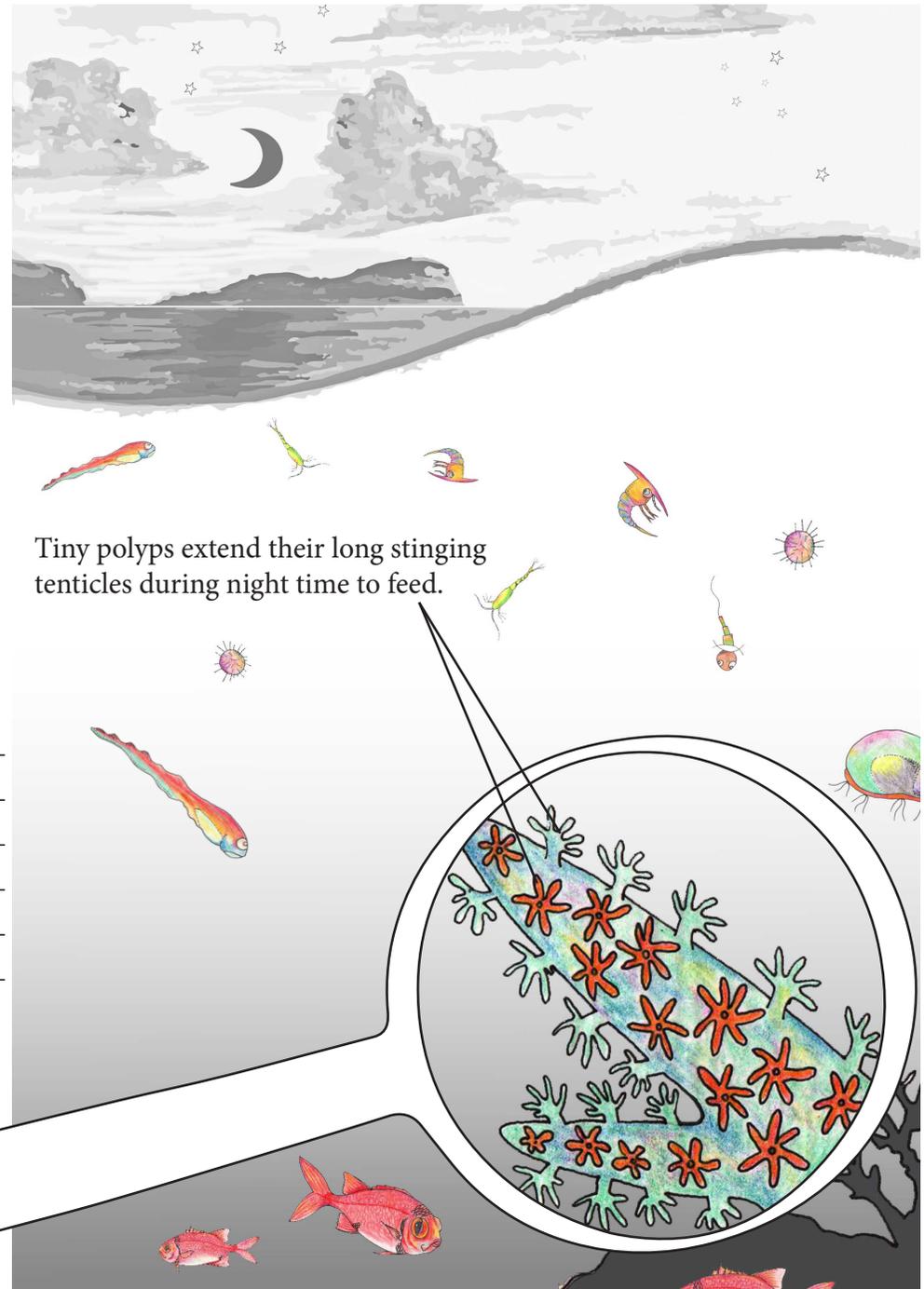
NIGHT TIME FEEDING

Corals also eat at night by catching tiny floating animals called ZOOPLANKTON. Corals extend their polyps to feed, reaching out with their long stinging tentacles to capture PLANKTON that is floating by. The plankton prey are then pulled into the polyps' mouths and digested in their stomachs.

Some plankton are capable of moving independently while others are at the mercy of the ocean current.

QUESTION:

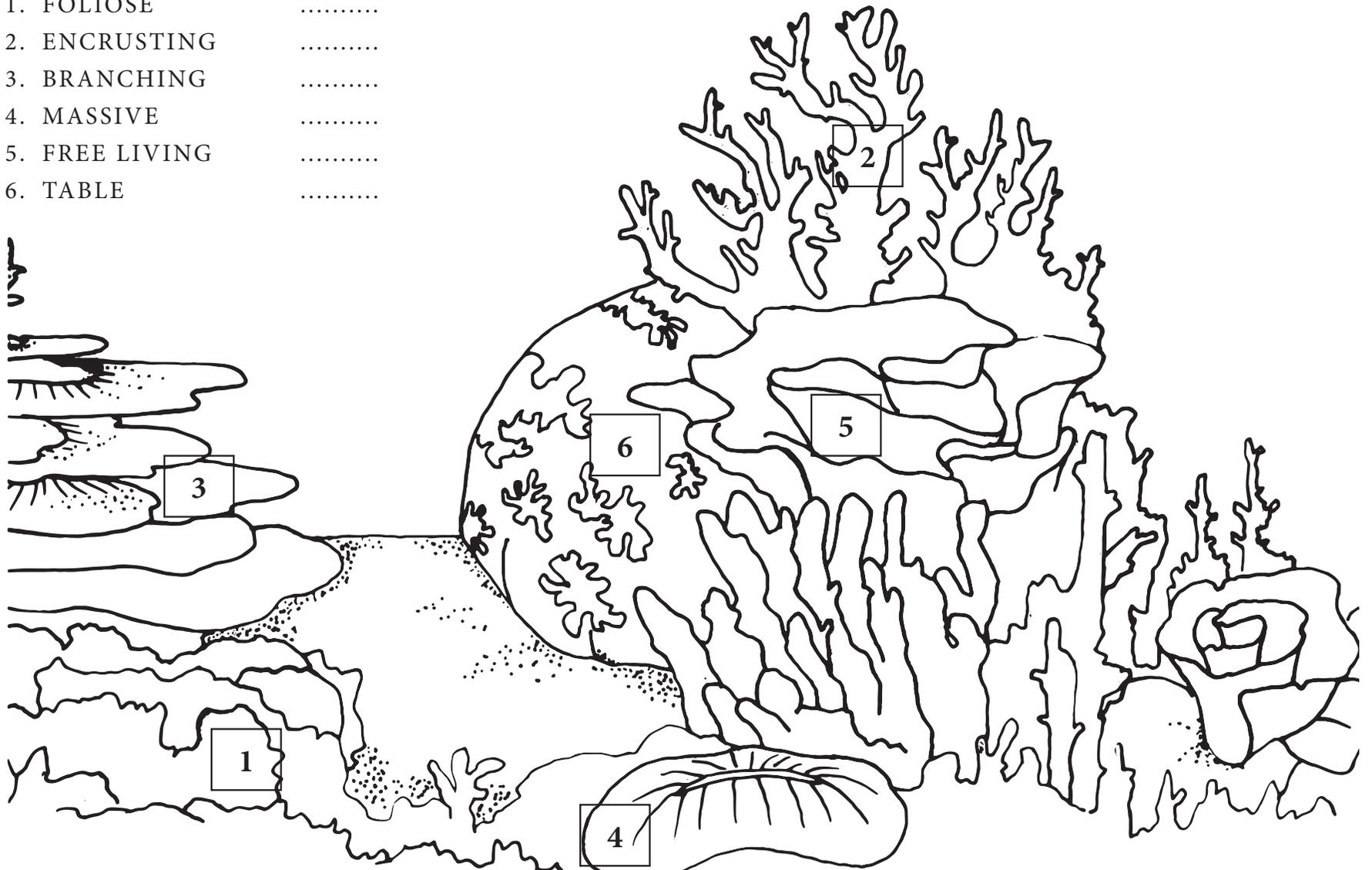
What do you think the prefix "zoo" means? How is phytoplankton different from zooplankton?



HARD CORAL COMES IN DIFFERENT SHAPES & COLORS

Activity: Color and label different coral shapes

- 1. FOLIOSE
- 2. ENCRUSTING
- 3. BRANCHING
- 4. MASSIVE
- 5. FREE LIVING
- 6. TABLE



ASEXUAL & SEXUAL REPRODUCTION

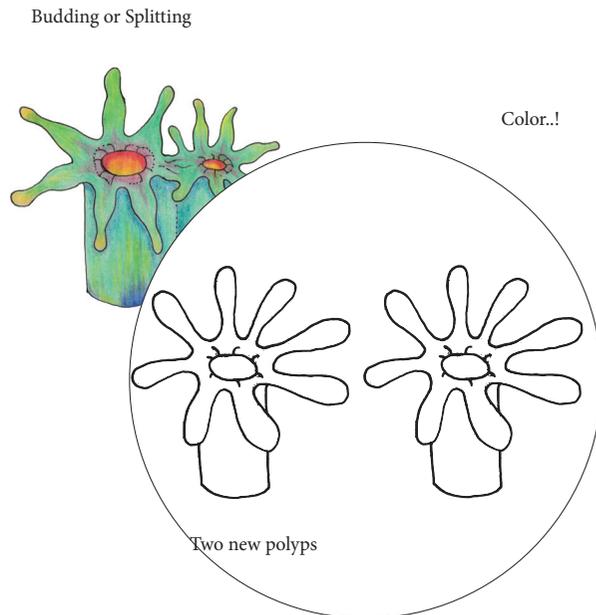
Reef-building corals reproduce both sexually and asexually.

Asexual Reproduction BUDDING OR SPLITTING

Asexual reproduction takes place in the form of budding or splitting polyps. In splitting, the original polyp divides (splits) in two to form two new polyps, then each of those polyps repeats the process, and so on. New colonies formed this way are an identical genetic reproduction of the first, so basically they are twins.

FRAGMENTATION

This happens when a whole piece of coral (branch for example) is broken off which then cements itself back on the ocean floor.



Sexual Reproduction BROADCAST & BROODER

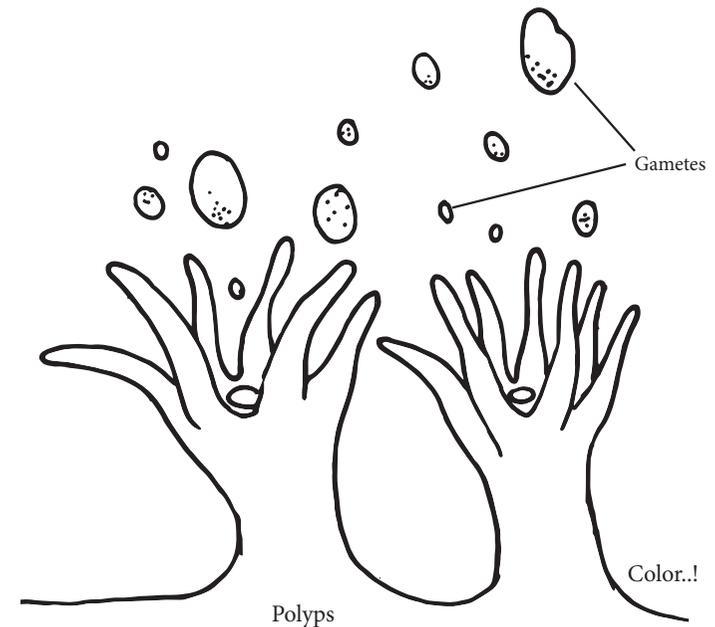
About 75% of reef-building corals are broadcast spawners, while the rest are brooder spawners.

BROADCAST

Broadcast spawning corals release gametes (eggs/sperm) into the surrounding water in large quantities. The gametes float to the surface where eggs and sperm join to form free-floating planula larvae. The larvae look like tiny cilia covered worms that can drift at sea until they find a suitable place to settle and start their own new colony.

BROODER

Brooding coral fertilize their eggs inside the polyp and release (almost like giving birth) a fully formed planula. Planulae are very regular in shape and covered with cilia to help them to swim.



LOCAL THREATS TO CORAL REEFS

American Samoa has some of the most prestigious corals in the world, unfortunately coral reefs worldwide are facing many threats, both at the global scale and at smaller, regional and local scales. Corals are resilient to change, but if subjected to ongoing stress, they may lose their resilience and be less able to survive or thrive in the long term. Most of these problems are caused by humans and can be solve by human thru collaboration efforts. Our goal is to maintain healthy and resilient reefs, and healthy and resilient human communities.

Local threats in American Samoa includes, Climate Change, Overfishing, Population Pressure, Land Base Source of Pollution and Crown of Thornes.

CLIMATE CHANGE

Climate change refers to changing patterns of the average rain, wind, temperature and storm events. Climate change impacts can be observed differently in different parts of the world. Some places may experience flooding while other areas may have droughts. The causes for these changes can be attributed to both natural and human activities. People have been burning fossil fuels over the years, which releases enormous amounts of CO₂ into the atmosphere. Excessive CO₂ in the atmosphere traps heat from the sun and warms up the Earth and its oceans. This will cause the sea level to slowly rise higher because the increasing temperature on Earth is melting the polar ice and glaciers. Excessive CO₂ absorbed into the ocean also changes the oceans pH making it more acidic, also called **ocean acidification**.

WHY IS THAT BAD FOR CORALS?

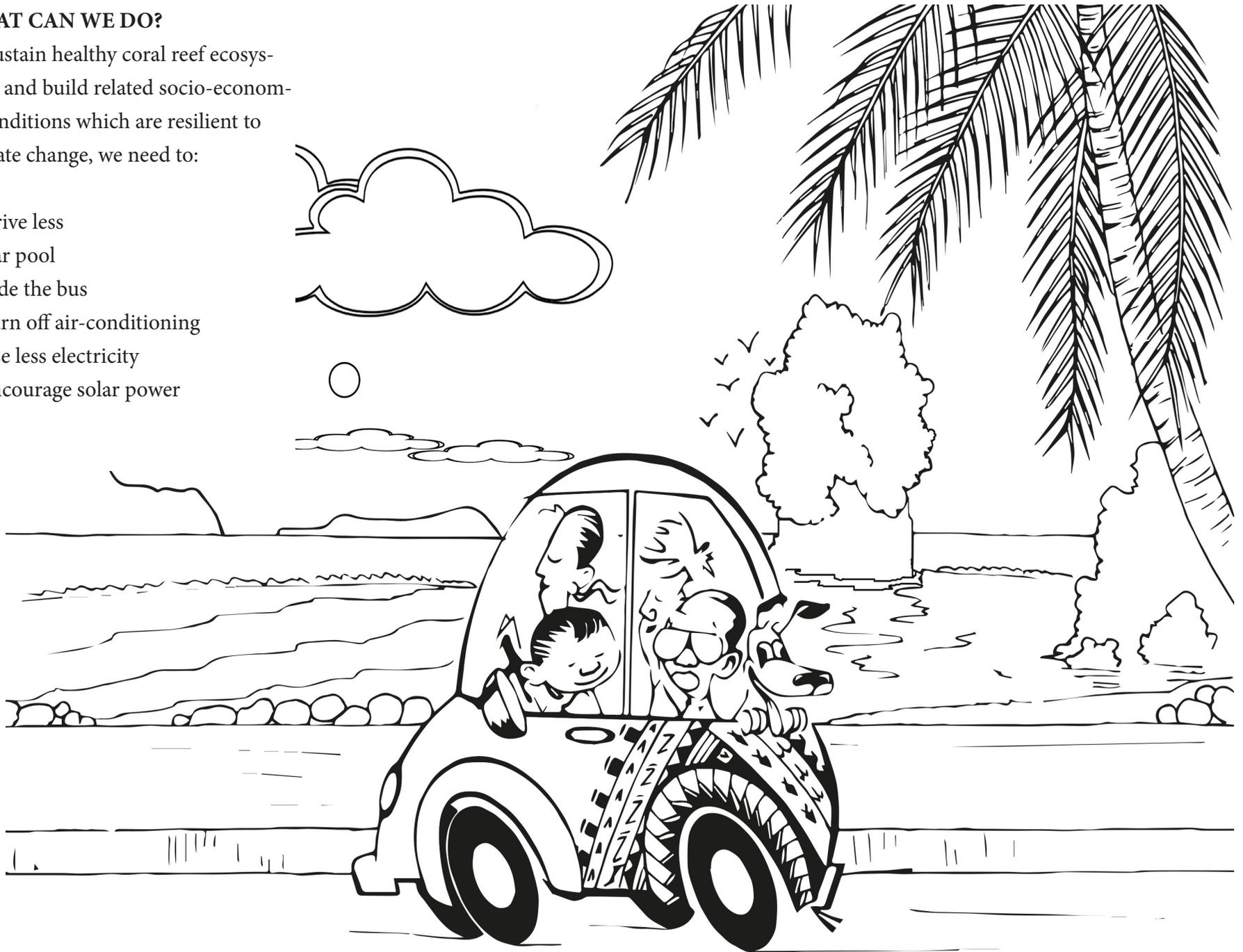
As temperatures rise, CORAL BLEACHING events (loss of zooxanthellae from the corals tissue causing the coral to turn bright white) and infectious disease outbreaks are becoming more frequent. When corals are bleached they are starving because they get most of their food from their zooxanthellae. If they are bleached a long time they will eventually starve to death. OCEAN ACIDIFICATION has already begun to reduce calcification and therefore growth rates of coral.

Coral reefs are vital to American Samoan fisheries and they also protect our shorelines and villages from storm surge and wave action. In the long-term, mass bleaching events and acidification will negatively affect corals by reducing growth and causing increased mortalities. This in turn will make coastal areas increasingly more prone to flooding, erosion and inundation from wave action.

WHAT CAN WE DO?

To sustain healthy coral reef ecosystems and build related socio-economic conditions which are resilient to climate change, we need to:

- 1: Drive less
- 2: Car pool
- 3: Ride the bus
- 4: Turn off air-conditioning
- 5: Use less electricity
- 6: Encourage solar power



POPULATION PRESSURE

Explosive population growth in American Samoa over the past 50 years has led to rapid development. Most of the population of American Samoa resides on the island of Tutuila, however, only approximately 30% of the land area has a slope of less than 30% and is considered habitable land.

Rapid human population growth, increased demand, use of more efficient fishery technologies, and inadequate management and enforcement have led to the depletion of key reef species and habitat damage in many locations and will continue as a result of unregulated human activities.

CLASS ACTIVITY: Population vs Resources



BE FRUITFUL AND MULTIPLY ...



NOW DIVIDE

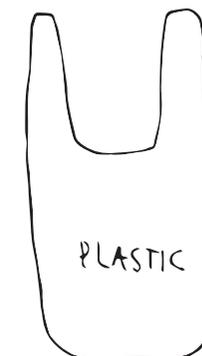
POLLUTION

Impacts from land-based sources of pollution, including coastal development (road construction), deforestation (clearing land for building houses and plantations), agricultural runoff (wastes from pig, chicken and vegetable farms), and oil and chemical spills (filling stations and workshops) can impede coral growth and reproduction, disrupt overall ecological function, and cause disease and mortality in sensitive species. Many serious coral reef ecosystem stressors originate from land-based sources, most notably toxicants, marine debris, sediments, and nutrients.

Marine Debris in the environment breaks down over a long period of time...!













Activity: How long until it's gone?

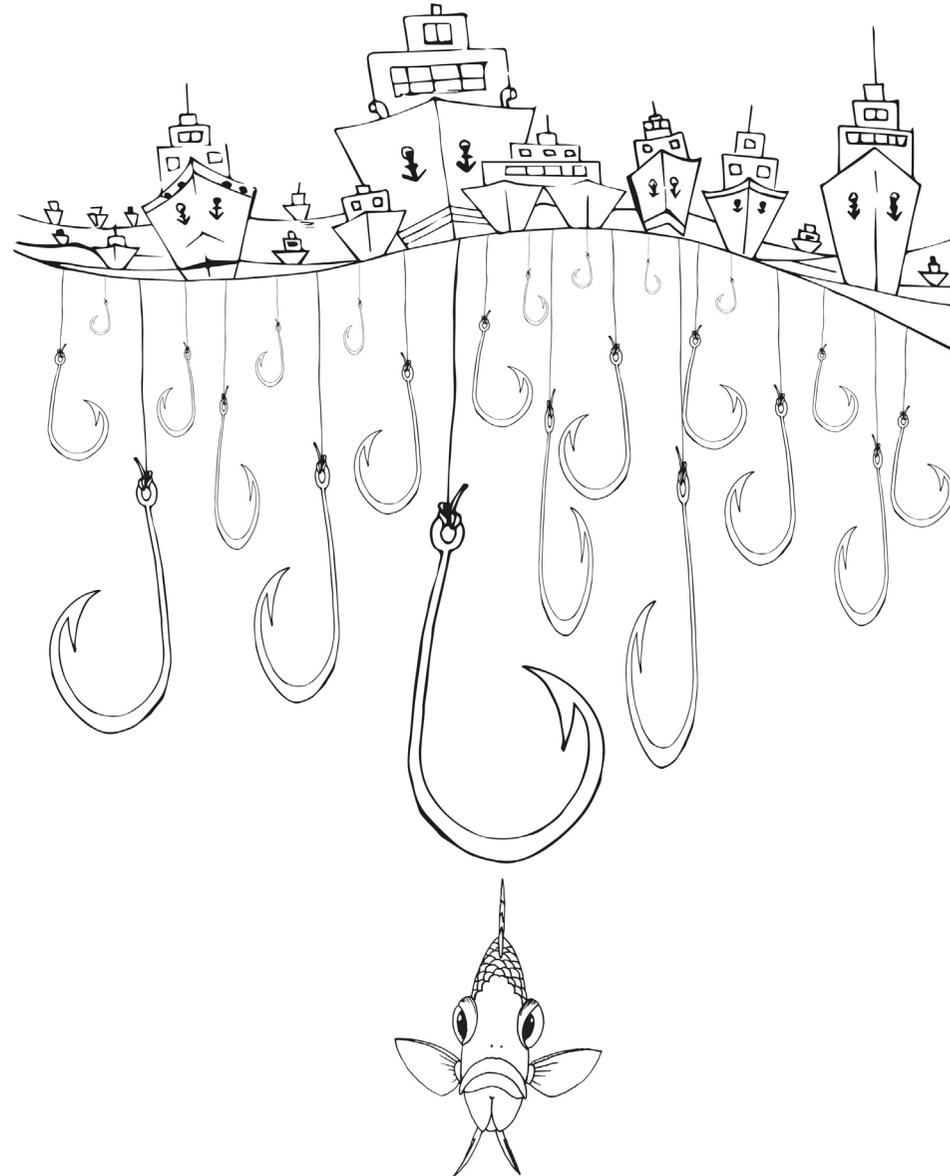
Use the number of years below to determine the number of years of each item on your right before it degrades.

Number of years
1 - 5 years
200 years
459 years
2 - 5 months
35 years
Undetermined

UNSUSTAINABLE FISHING (OVERFISHING)

Coral reef ecosystems have supported our people for thousands of years and continue to provide important commercial, recreational, and subsistence fisheries resources in American Samoa. Fishing plays an important social and cultural role in our islands and communities, and it is often also a critical source of food and income.

Coral reef fisheries, though relatively small in scale compared to tuna fisheries for example, may have disproportionately large impacts on the ecosystem if conducted unsustainably. Additionally, certain types of fishing gear can inflict serious physical damage to coral reefs, seagrass beds, and other important marine habitats. Overfishing and destructive fishing can damage the health of the reefs. Removal of herbivorous fish for example will allow algae to grow and compete with the coral for space and sunlight. Losing coral reefs often has a ripple effect, not just on the coral reef ecosystems themselves, but also on the local economies that depend on them.

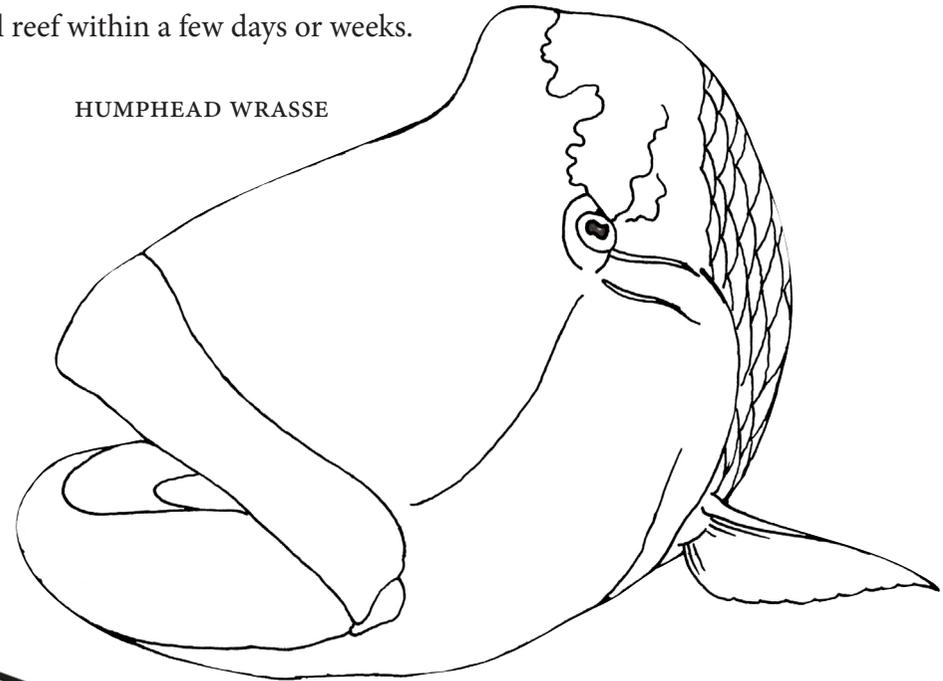




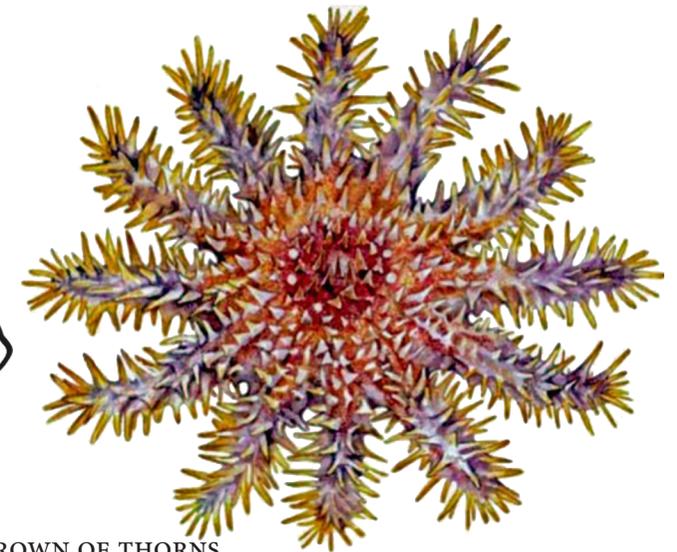
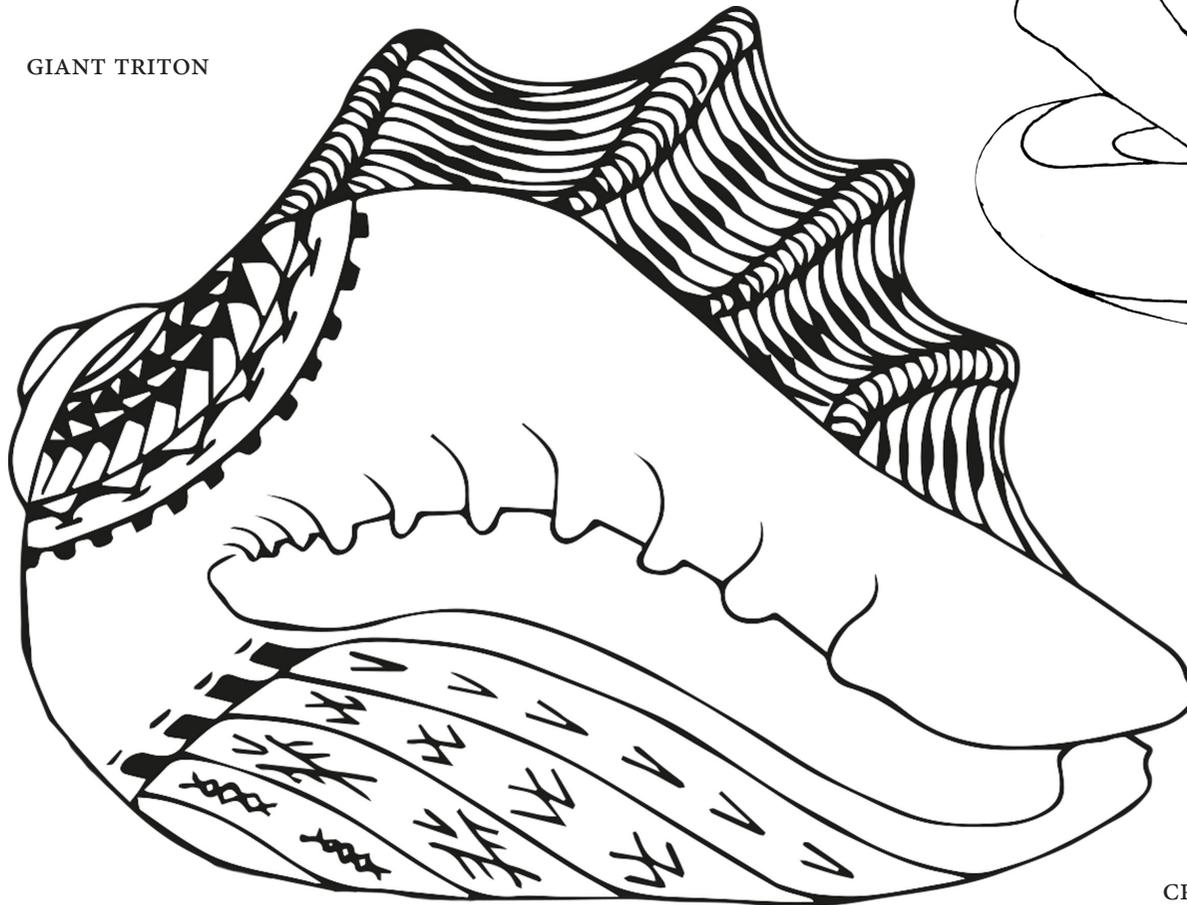
CROWN OF THORNS (COTs) *Acanthaster planci*, is a large redish brown starfish or sea star with up to 23 arms. It reaches a diameter of over 35 cm and is covered with sharp spines up to 5 cm long. It occurs naturally on coral reefs throughout the Indo-Pacific Region and they feed on coral polyps. An outbreak of COTs can be very damaging to reefs and have been known to kill large areas of coral reef within a few days or weeks.

Predators of crown-of-thorns include large molluscs such as the giant triton and the helmet shell, as well as fish such as the humphead wrasse, and the stellate puffer fish.

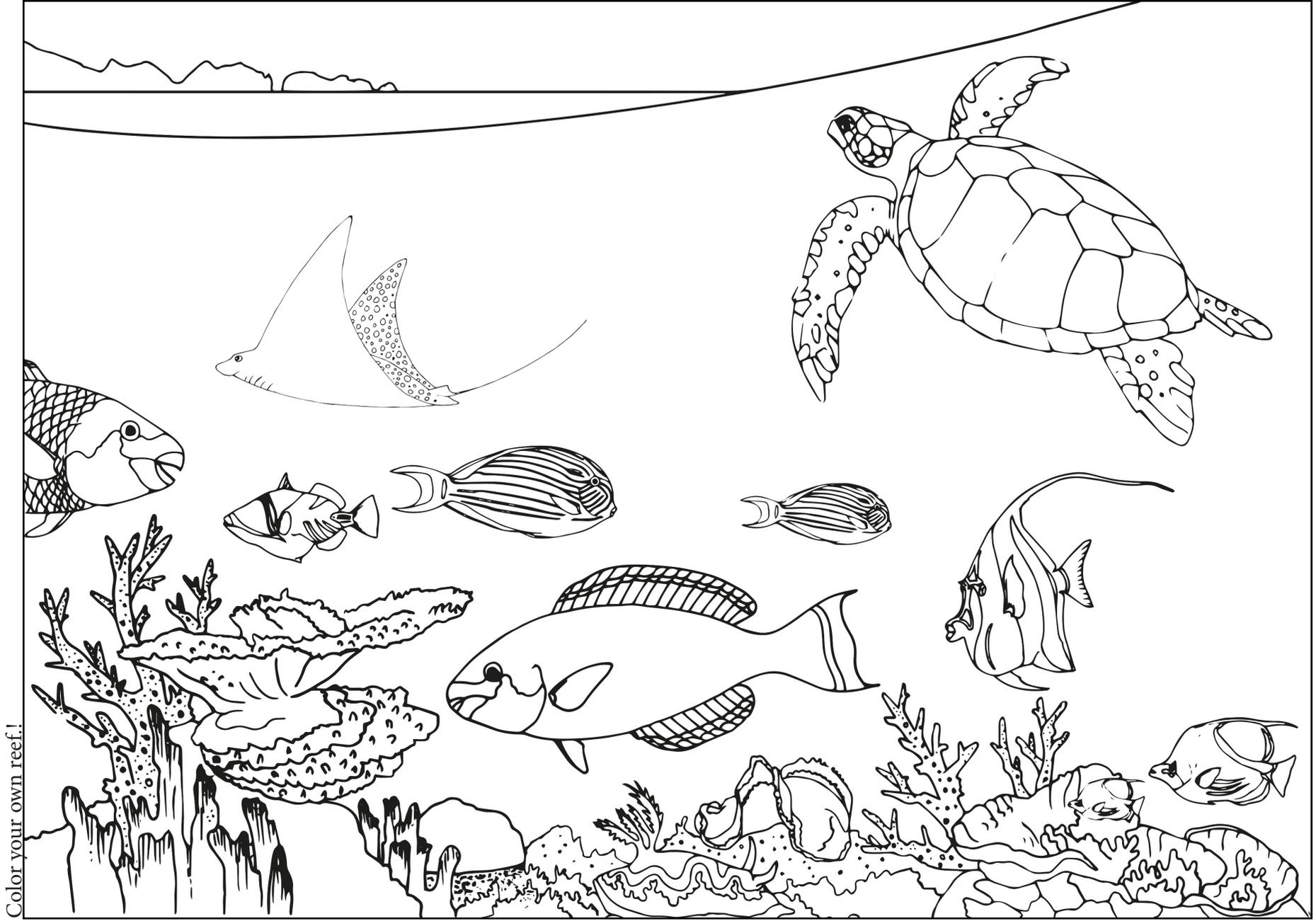
HUMPHEAD WRASSE



GIANT TRITON



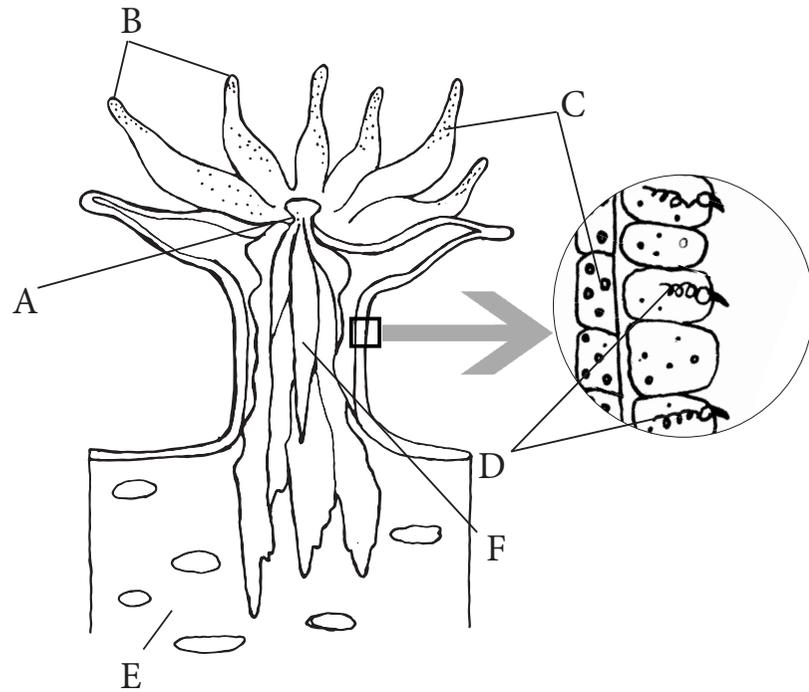
CROWN OF THORNS



Color your own reef.!

SEE WHAT YOU HAVE LEARNED SO FAR ...

Label each structure of the coral polyp and state the function of that structure.



	STRUCTURE NAME	FUNCTION
A		
B		
C		
D		
E		
F		

Multiple Choice Questions: Circle the right answer.

1. What is a coral?
 - a. Rock
 - b. Plant
 - c. Animal
 - d. All of the above
2. How much of Earth's surface are covered in coral reefs?
 - a. Less than 1%
 - b. 1% to 5%
 - c. 25%
 - d. More than 50%
3. Increasing sea temperature causes corals to bleach.
 - a. True
 - b. False
4. What is/are the threat(s) to coral reefs
 - a. Climate Change
 - b. Destructive fishing methods
 - c. Pollution
 - d. All of the above
5. What environmental factor does a coral reef need to stay healthy?
 - a. Murky water
 - b. High nutrients
 - c. Water circulation
 - d. Less sunlight
6. Threats facing coral reefs include
 - a. Proper disposal of trash
 - b. Discouraging the cutting down of mangroves and other trees
 - c. Removing Herbivores (eg: Parrotfish) from the reefs
 - d. Reduce carbon emission
7. Things to consider during snorkeling include
 - a. Stand on the reefs when you're tired
 - b. Touch something when you're not sure of what it is
 - c. Do not touch any sea creature and check on your friend regularly
 - d. Don't worry about the currents or waves as long as you look cool underwater.
8. Coral reefs are massive structures made of calcium carbonate deposited by coral animals which form the base of the complex reef ecosystem.
 - a. True
 - b. False
9. What is a coral reef made of?
 - a. Limestone (Calcium Carbonate)
 - b. Flint
 - c. Quartz
 - d. Rock
10. Coral reefs contribute to the local economy
 - a. True
 - b. False
11. Coral feed during day and night times.
 - a. True
 - b. False

12. In general corals grow very slow about 1 to 2 inches per year.

- a. True b. False

13. Coral reefs provide homes for fish

- a. True b. False

14. Destructive fishing threatens coral reefs worldwide.

- a. True b. False

15. Too much algae is bad for the reef.

- a. True b. False

16. More people on island will put more pressure on our natural resources.

- a. True b. False

17. Clear water is a good sign of ocean water quality: Healthy water = Healthy reef.

- a. True b. False

18. During day time corals utilize a tiny single-celled alga called zooxanthellae to make their food just like plants on land do.

- a. True b. False

19. Coral polyps use stinging tentacles to catch micro-organisms such as plankton.

- a. True b. False

20. Marine Science is awesome.

- a. True b. False

Read the statements about coral reefs below. Put an N next to the natural threats, and an H next to the human threats.

_____ 1. Marine debris can impact coral reef habitats.

_____ 2. Gardening near streams encouraging siltation leads to smothering the corals.

_____ 3. Natural predators, such as crown of thorns and parrotfish, eat the corals.

_____ 4. Snorkelers and divers can damage the reef by hitting the corals with their fins.

_____ 5. Collecting tropical fish for personal use or resale damages the reef.

_____ 6. Tropical storms and hurricanes can break the corals.

_____ 7. Illegal fishing and over-fishing can spoil the reef ecosystem.

_____ 8. Agriculture can smother corals with sediments.

_____ 9. Chemical and thermal waste, fertilizers, and sewage affect the water quality.

_____ 10. Temperature increases caused by climate change may cause coral bleaching.

SOURCES:

SEA – Sea. Earth. Atmosphere: Come Explore the World of Science. Grade 3, Page G3U3L3 1- 17.

<http://coralreef.noaa.gov/education/educators/resourcecd/activities>

<http://coralreef.noaa.gov>

<http://coralreef.noaa.gov/issues/welcome.html>

<http://coralreef.noaa.gov/issues/fishing.html>

<http://coralreef.noaa.gov/issues/lbsp.html>

<http://www.nature.org/ourinitiatives/habitats/coralreefs/ways-to-help-coral-reefs/>

<https://eorhawaii.org/>

<https://eorhawaii.org/2015/12/08/interesting-video-on-corals/>

<https://agoodhuman.wordpress.com/2009/11/04/environment-1-the-issue-of-human-population-growth/>

<https://seaworld.org/en/animal-info/animal-infobooks/coral-and-coral-reefs/reproduction>



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