

Acknowledgments:

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Written & Illustrated by Cara Lin, Guam Department of Agriculture, as part of the National Coral Reef Fellowship 2020-2022, revised December 2023





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Additional sources and thanks to:

Guampedia:

"Pole and Thatched Homes" by Lawrence Cunningham

"Mangroves: The Forest between Land and Sea" by Mildred Kelokelo

"Hima: Conserving a Cultural Heritage" by Francisco Villagomez

Water and Environmental Research Institute of the Western Pacific (WERI) and Island Research & Education Initiative (IREI)- Digital Atlas of Guam

Fish Names of the Mariana Islands, Micronesia, University of Guam Marine Laboratory Technical Report 13, February 2012 compiled by Alexander M Kerr

Guam's Fish and Wildlife Factsheets (May 2002), funded by the Guam Environmental Protection Agency pursuant to the United States Environmental Protection Agency Award # M009063-02 through the Environmental Education Committee of the Water Planning Committee.

https://www.guampedia.com/fish-and-wildlife-fact-sheets/

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Learn more from the Guam Coral Reef Initiative:





Greedings-Ocean-Explorer?

Thanks for joining our adventure! We are going to explore three coastal **HABITATS** you can find around Guam. **A habitat is a place where animals and plants live.** Healthy habitats provide animals things they need, such as

food and shelter.



Hafa adai, I'm Metgot the Mangrove!

In CHamoru the word "metgot" means strong! I am a strong type of tree that can survive in or near salt water.

What is your name?

My name is:





Salutations! I am Seba the Seagrass!

Unlike the grass on land, I live in salty ocean water. The CHamoru word "seba" means to give a lot, and I create a lot of homes for fish.

Join us on our adventure! **Draw yourself below:**

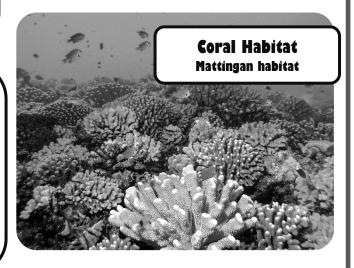




Buenas, I'm Åcho' tåsi the Coral!

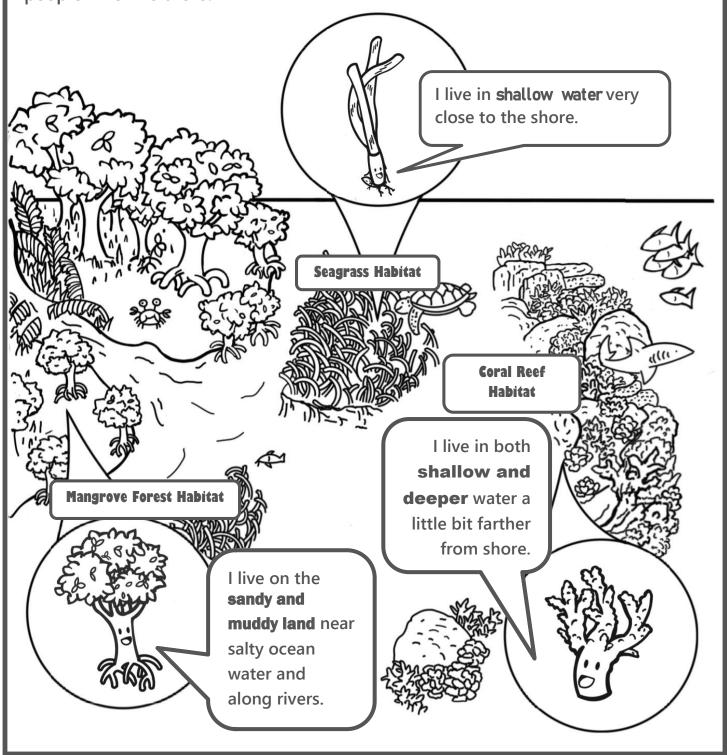
I am an animal with algae (little plants) inside me.

Quick tip: <u>underlined words</u> are a question or challenge for you. Some have answers in the back.



Where-do-we-live?

The mangroves, seagrasses, and coral reefs of Guam are along the coast. The habitats look different but are all connected. Animals like sea turtles and fish (can you spot them?) move between the habitats for food or as they grow up.



What are seagrasses?



Seagrasses are related to land plants! They also make food using energy from the sun and have flowers that make seeds.

New seagrass can grow from seeds **OR** they can grow along the **rhizome**, which is like a stem but underground.

The **rhizome** allows seagrasses to share nutrients (food) and grow quickly horizontally.

How are these two plants similar and different? Flower Blade or Leaf Rhizome Roots Soil and Sediment Land Plant Seagrass

Guam has 3 types of seagrasses. Tape grass is the most common and largest type.

Observe the pictures below and compare the 3 seagrasses. Can you draw a line to match each leaf type and root type to the correct seagrass?

Needle Grass



Tape Grass



Spoon Grass



Leaf type

Oval shaped blade comes in pairs

Wide blade, rounded tip

Narrow blade

Root type

Small thin roots

Medium sized roots

-Super-seagrass-roods?

Roots help plants get nutrients and keep the plant anchored in place.

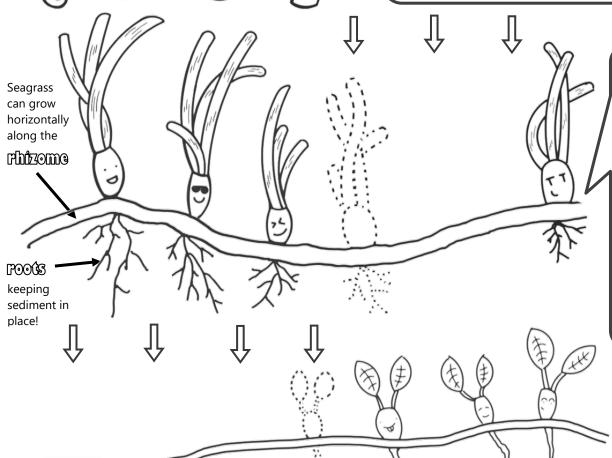
Without enough plant roots keeping the soil in place, the soil can get loose and wash from the land into the sea, where it gets stirred up by waves. Soil that gets moved around by water is called SEDIMENT.

Especially on steep hills, rain can wash sediment into the ocean. If the sediment lands on the corals it can smother and hurt them.

It takes teamwork! All plants with roots help keep the soil in place. The forests and plants on land, the mangroves, and seagrasses all help protect corals.

Help protect us corals from sediment!

Draw in the missing seagrass under the arrows below! Make sure you draw the roots to keep the sediment in place!

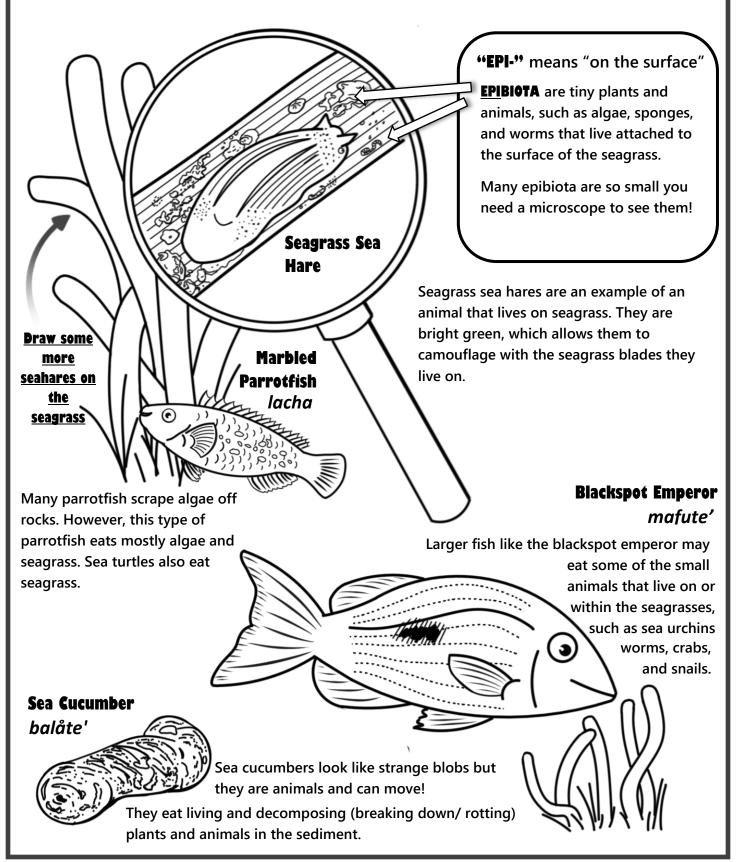


You can also help protect corals by planting trees, and avoiding off-roading, which can tear up the plants.

Bonus Challenge! There are two species of seagrass on this page. Which one is tape grass and which one is spoon grass? *Answer on page 25

What-lives-in-the-seagrass?

Seagrasses are a great habitat because they provide many creatures with **food** and **protection**. Fish can hide in between the seagrass, and some tiny plants and animals even use the surface of the seagrass as their home. Let's take a closer look!



What are mangroves?

Mangroves are trees that can grow in a mix of salty and fresh water.

Guam has many species of mangroves with **different shaped** roots. Some mangroves like very salty water and grow very close to the ocean. Some like less salty water and grow farther from the ocean.



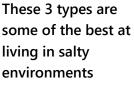
at .

Large-leafed Orange Mangrove

Mångle' macho'

Red Mangrove *Mångle' hembra*

Grey mangrove *Mångle' åpu*









Knee Roots

Prop Roots

Spike roots





What are those three things that look like long string beans?

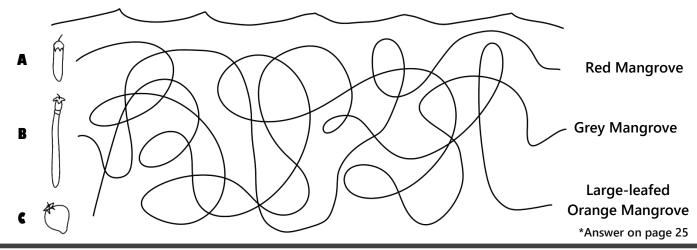
Some mangroves have seeds and others have propagules.

What's the difference?

SEEDS leave the parent tree before growing

PROPAGULES start growing while still attached to their parent tree

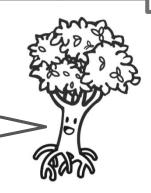
A propagule floats around until it eventually sinks or and starts to grow roots. Different types of mangroves have different propagules. Follow these propagules as they float in the waves to match them to the mangrove type.



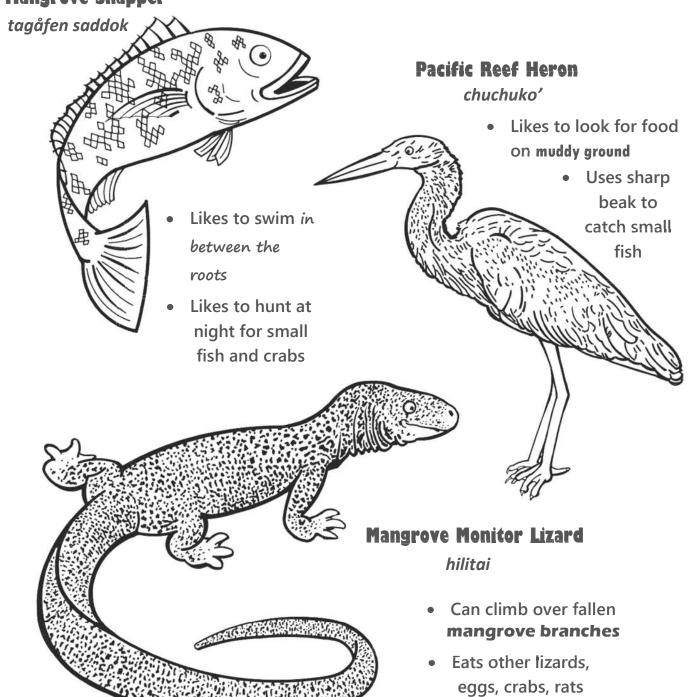
What-lives-in-the-mangroves?

There are all sorts of animals you can find living among the mangrove trees.

Can you draw the foods these animals eat and the mangroves around them?



Mangrove Snapper



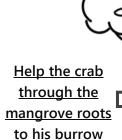
Mangrove-Rood-Maze

Mangroves are great habitats for ocean life because of their complex roots! **Fish can hide in the spaces between the roots**, safe from predators. Little animals like **snails and crabs** also crawl on the roots.

Mangrove propagule

Circle all the propagules you

<u>can find</u>



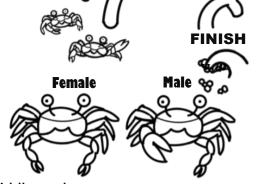
*Answers on page 26

Mangrove habitat underwater:

During high tide the mangrove roots are underwater, allowing animals to swim by



Here is a group of glassfish sheltering among mangrove roots.



Fiddler crabs are common near mangroves.

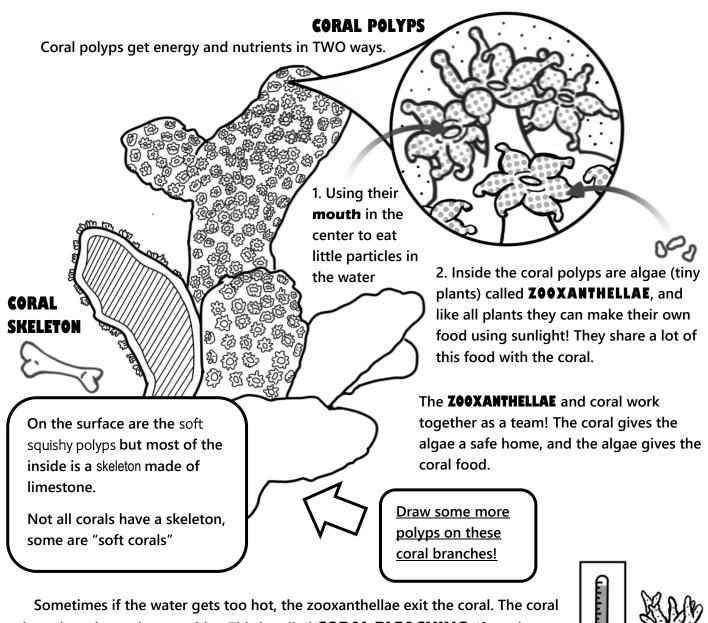
Male fiddler crabs have one big claw.

Circle the males and draw a triangle around
the females

What are corals?



Let's take a closer look at coral. The coral is actually made up lots of tiny **CORAL POLYPS- a ring of tentacles on a stalk.** The polyps are connected and can share nutrients. The coral grows larger by making copies of the polyps over a limestone skeleton. Let's take a closer look.



Sometimes if the water gets too hot, the zooxanthellae exit the coral. The coral loses its color and turns white. This is called **CORAL BLEACHING**. If coral stays bleached for too long it can die.













Color these corals, make
sure these different
kinds of corals aren't
bleached!

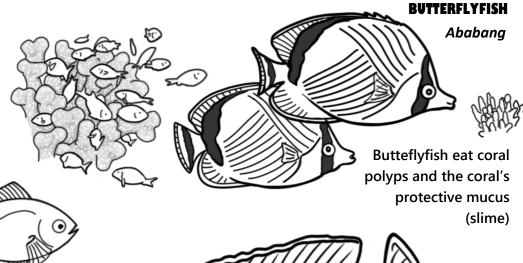
Goral-Reef-Greatures



Together, lots of corals make the **REEF- a hard structure strong enough to not get washed away by waves.** Animals can hide around and in between the sturdy coral branches. Creatures big and small can also find food at the coral reef.

Damselfish *Fohmo*

Many damselfish like the blue green chromis are small and quick to hide in between coral branches. They eat small animals drifting in the water.



HUMPHEAD WRASSE

Tangison

wrasse is one of the **largest** coral reef fish. It can live for over 30 years and grow to over 7 feet long. (How tall are you?)

The Humphead





CROWN-OF-THORNS SEA STAR

This sea star eats corals, and too many crown of thorns sea stars can damage the coral reef.

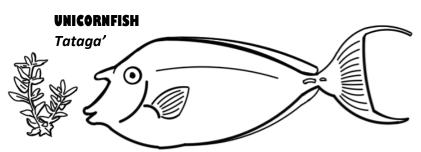
* check out this sea star on page 24 too!

Too much fishing can lower the fish population. Since different fish have different jobs, **it is important to protect fish to protect the coral reef.** Read more about fish jobs on the next page.

Different-fish-with-different-jobs-



The coral reef is home to hundreds of kinds of fish. Different fish eat different things, almost like having different jobs. **Having lots of different kinds of fish helps keep the coral reef healthy.**



Unicornfish are **important for eating seaweeds.** They help prevent the seaweed from overgrowing into seaweed forests and hurting the corals by blocking out sunlight, and taking up too much space.

PARROTFISH

Parrotfish scrape off short fuzzy algae from rocks and dead corals. They help clean up the rock and open up new space for baby corals to attach and grow.

Palaske'= small parrotfish
Laggua= large parrotfish

<u>Create a fish! Think about what kind of role it has on the reef and fill out the information box.</u>

Draw your fish in the box below:	Fish Name:		
	What food(s) does it eat?		
	□ seaweed □ fuzzy algae □ seagrass		
	□ other fish □ coral □ shelled animals		
	☐ left over scraps from other animals		
	□ other:		
	What animal(s), if any, eats it?		
	What habitat(s) does it live in?		
	□ coral □ seagrass □ mangrove		

Growing-up-in-the-nursery:

Can you

its adult form?

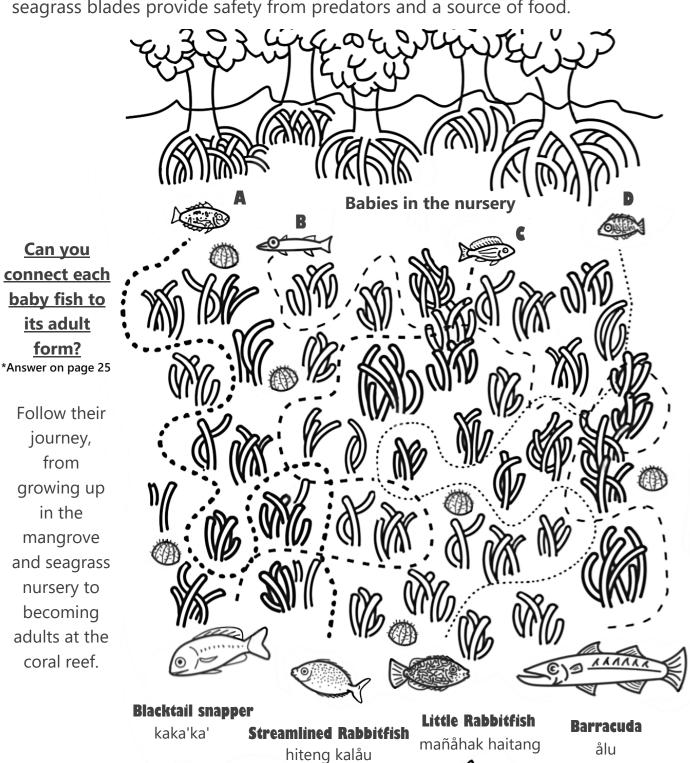
journey, from

in the mangrove

nursery to becoming

coral reef.

Some types of fish use the seagrasses and mangroves as a **NURSERY habitat-a** place where young fish can grow up. As they grow bigger they may migrate (move) to the coral reef to spend their adult life. For babies, the mangrove roots and seagrass blades provide safety from predators and a source of food.



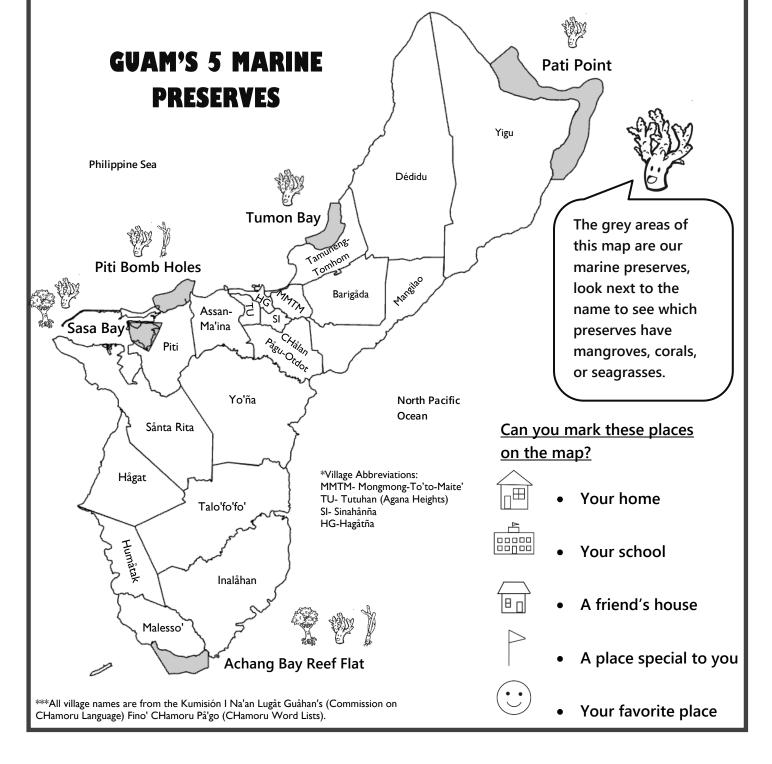
Adults at the coral reef

-What-are-marine-preserves?



To **PRESERVE** means to protect something from being damaged. **A marine preserve** is a place that protects ocean habitats and the plants and animals that live there.

In the **marine preserve** there are special rules for fishing. The fishing rules help make sure we have enough fish for future generations and help keep the coral reef healthy.



ltural-connections--materials-



The ancient CHamoru people used many natural materials to help them build homes, clothes, fishing equipment, and other tools. Some of these natural materials came from our coastal habitats.



The nipa palm can be found near the mouth of rivers.

They grow well in water that is mostly fresh water but has a little bit of salt mixed in too.

Currently there aren't that many areas with Nipa Palms in Guam so they are protected.

Add some thatching to the The most popular plant for thatching (covering) roofs was the coconut palm. However, in the past the leaves of the nipa palm were also used.

Hima (Giant Clams)

Giant clams live in the coral reef and their shells were used for making necklaces and blades.

A **balanggai** was a get together where people would invite friends and family to help with roofing. While they worked people would feast, sing, and have fun.

frame of this roof

Wood & Rope

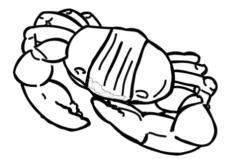
Piece of clam shell

Higam were axe-like tools made from giant clam shells that were used to carve canoes.

Gultural connections- seafood

Do you enjoy eating seafood? There is a long cultural tradition of seafood in Guam that is supported by our coral, seagrass, and mangrove habitats.





Pånglao

Land crabs use the mangrove habitat and create burrows in muddy mangrove sediments. The crabs are cooked to create stuffed land crab, pånglao.



Mañåhak are young

rabbitfish. They are often eaten fried or pickled to use as a condiment (topping).



Talayeros, or fishermen using a fishing net called talaya, catch mañahak from shore. Mañahak live and eat in seagrass.

Kelaguen Gåmson

Octopuses like to hide in small Octopus kelaguen is usually eaten for special occasions. spaces in the Kelaguen dishes "cook" meat using lemon juice. coral reef. Coconut, onions, salt, and donne' (peppers) are other ingredients common in kelaguen.

In Guam, you may catch octopus to eat by yourself or with friends and family, but it is illegal to catch to sell them, and illegal to catch them in preserves.

This rule is important because if we catch too many octopus there won't be enough left to reproduce. These fishing rules are important for keeping the coral reef healthy so seafood can be enjoyed by future generations.

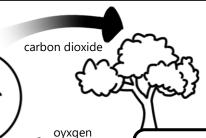
Carbon-Capture-Masters



Breathe in, breathe out. When humans and animals breathe they use the **oyxgen** gas and breathe out **carbon dioxide**; plants do the opposite and use carbon dioxide gas and release oxygen.

Cars, planes, farm animals, and coal power plants also release carbon dioxide.





Over time we have cut down a lot of trees.

The planet is no longer in balance.

The CARBON DIOXIDE causes the planet's temperature to rise.

The high temperature causes changes in long term weather and affects how often it rains or storms.



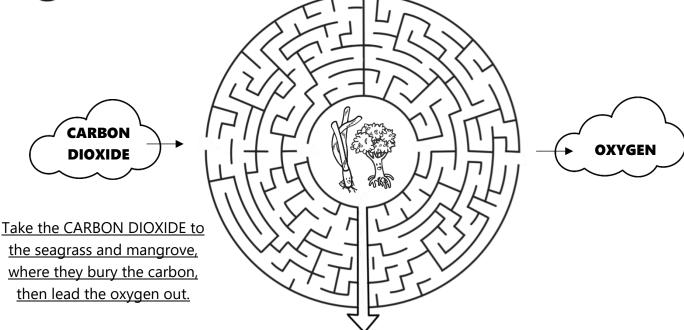








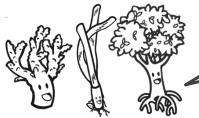
Seagrasses and mangroves can help! They absorb a lot of carbon dioxide. Eventually old leaves and roots get buried, and the carbon gets buried in the mud, keeping carbon dioxide out of the atmosphere and **bringing back balance.**



*Answer on page 25

CARBON BURIED UNDERGROUND

-Wave-absorbers-maze



Can you see the difference between the two pictures below?

Together we work as a team to absorb the energy of big waves coming from the sea.

Calm waves by the land

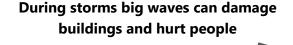


Healthy coral reefs, seagrasses, and mangroves



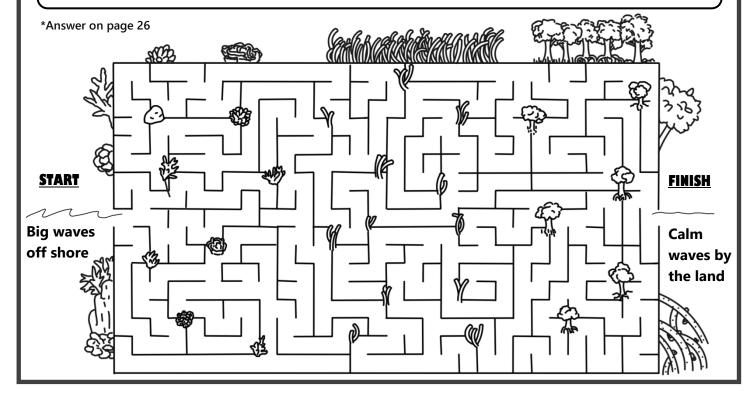


Unhealthy or dead coral reefs, seagrasses, and mangroves



Larger waves and no plant roots holding together the sediment also causes greater coastal EROSION- the process where the waves wash the land into the sea slowly over time.

<u>Wave Maze Challenge:</u> Pretend you are the wave! As you travel through the coral reef, seagrasses, and mangroves, <u>show how the wave energy reduces with how squiggly your line is!</u>

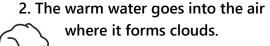


Wonderfull-water--from-ridge-to-reef



To protect ocean life we need to protect our water. But that can be difficult because water is always moving in the **WATER CYCLE**.

1. The sun heats up water in puddles, ponds, and the ocean.



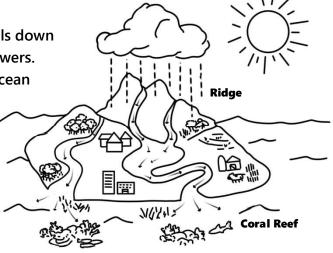
3. Water rains down from clouds

4. The cycle repeats

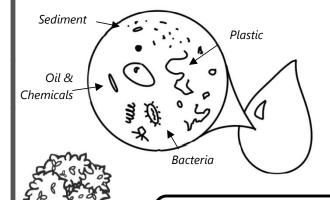
FROM RIDGE TO REEF

What goes up must come down!

Rain on top of the high mountain ridges travels down through the hills, fields, rivers, villages, and sewers. Finally the water ends up in the ground and ocean



INSIDE A WATER DROPLET



As the water travels, it can get polluted. **Pollution** is anything added to the environment that causes harm to living things.

Some pollution you can see, like big pieces of plastic or cloudiness from dirt. Other types of pollution like oil, other chemicals, and very tiny pieces of plastic cannot be seen without special tools.

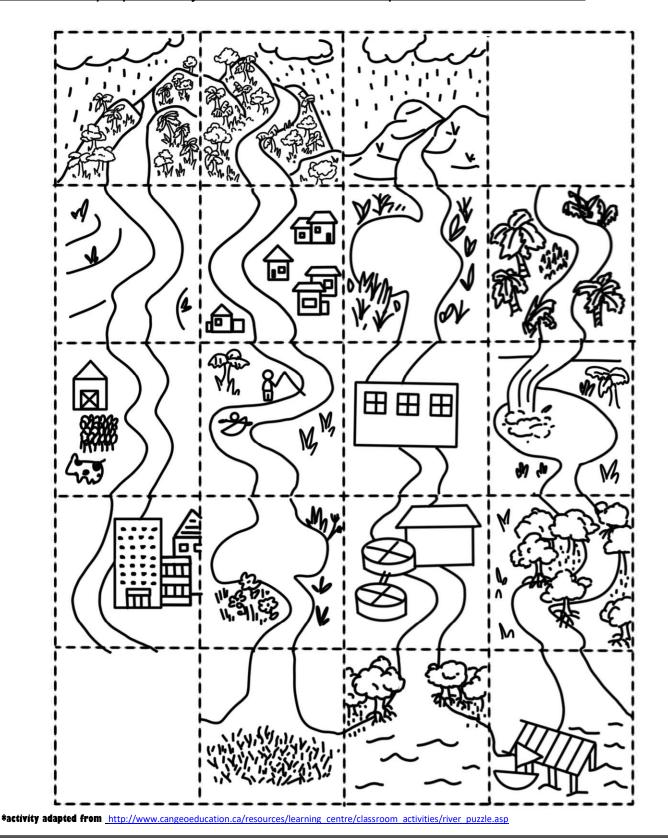
In order to protect the water reaching the coral reef, we need to start all the way at the beginning at the ridge at the top of the mountain!

On the next page make your own ridge to reef landscape that will help keep the water clean!

Wonderful-water-from-ridge-to-reef-

A **WATERSHED** is an area of land that collects and drains all of the water on it into a larger water body such as a lake, pond, or the ocean.

Cut out these squares below. See if you can arrange them into a watershed that will keep the coral reef and people healthy. Look on the back of the squares for more information.



Inside each square is some more information about the scene on the other side. Look for where pollution is created and where it is absorbed and arrange the squares to help make sure the pollution is absorbed for the safety of the corals and people. See more information about this activity on the other side of this page

Free Space- you decide, you draw!	Badlands- areas where there aren't a lot of plants, which causes soil to wash away easily	Mountain Ridge- the highest point where the rainfall starts flowing down	Mountain Ridge- the highest point where rainfall starts flowing down
Forest- when it rains, forests help absorb water, clean water, and keep the soil in place	ains, forests special gardens telp absorb that help absorb vater, clean lots of rainwater vater, and keep to protect people		Badlands- areas where there aren't a lot of plants, which causes soil to wash away easily
Waterfall recreational area- water needs to be clean for people to swim	Water treatment facility- place where water gets filtered and cleaned	River Park- water needs to be clean here since people fish and play in the water	Farm- great source of local food! However animal poop and fertilizer may go into the water.
Mangrove forest- helps absorb sediment and pollution	Sewage Treatment Facility- where water with human waste (poop) gets cleaned	Rain Garden- special gardens that help absorb lots of rainwater to protect people from flooding	Hotels and Businesses- many people, might create human waste and pollution
Marina- area where people keep and launch boats.	Mangrove shoreline- helps absorb sediment, pollution, and wave energy	Bay with seagrass- helps absorb sediment and pollution	Free Space- you decide, you draw!

Litter-fires-eess!

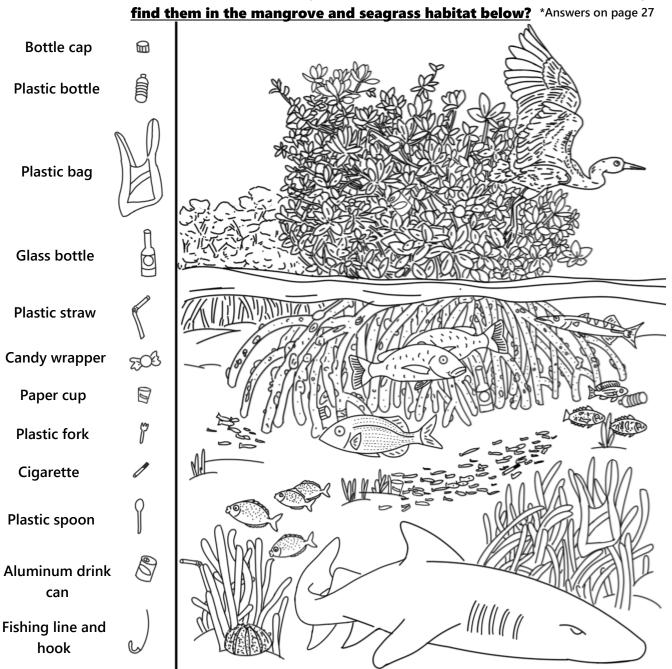


Trash that isn't thrown away correctly and ends up in the environment is called **LITTER.**Litter is a big problem. Animals like fish or birds may eat bits of plastic and get sick. Other animals like sea turtles can get tangled in old nets or fishing line and drown.

Litter is also harmful to people. No one wants to swim at a beach full of garbage, step on broken glass, or eat fish and seafood that ate plastic!

You can help by reducing how much trash you create- only buy things you need and avoid single use plastics. You can also pick up litter you see and join clean up events!





BONUS CHALLENGE: put a STAR next to items you CAN recycle, and CROSS OUT items you CANNOT recycle

Be-the-eyyes-of-the-reeff



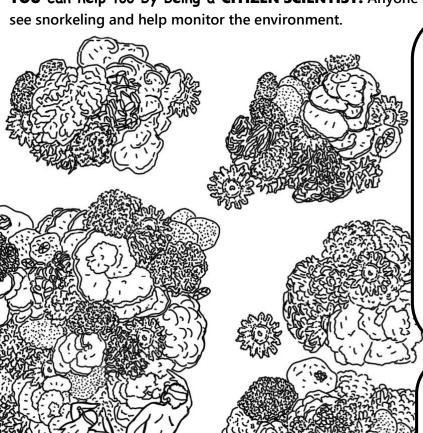
To **monitor** something means to watch it carefully for changes over time. **Scientists** monitor the coastal habitats to see if they are changing or staying the same. Changes can be good, bad, or neutral (neither good or bad).

For example, scientists can monitor seagrasses by measuring the amount of seagrass and counting the number of fish in the seagrass.

If that area increased in seagrass and number of fish, the seagrass is likely healthy. If that area **decreased** in seagrass or number of fish, the seagrass is likely unhealthy and there might be a problem like pollution or too much fishing.



YOU can help too by being a CITIZEN SCIENTIST. Anyone can be a scientist if they record what they



The Crown-Of-Thorns Sea star (also known as **COTS**) is a large spiky venomous sea star. If there are too many COTS they eat too much coral and hurt the reef.

Can you help the snorkelers find all the crown-of-thorn sea stars below and record them in the report?



*hint- some may be hiding under coral

Reports help scientists know how many COTS are on the reef.

Coral Reef Monitoring Report:

Location: Gun Beach					
Date:/					
Name:					
Number of crown of thorn sea					
stars:					

*Answer on page 28

Get involved in Guam's citizen science monitoring program and help monitor coral reefs! Report your real crown-of-thorns sea star sightings and other observations at www.eormarianas.org

Become-a-steward-of-the-land-and-seaf

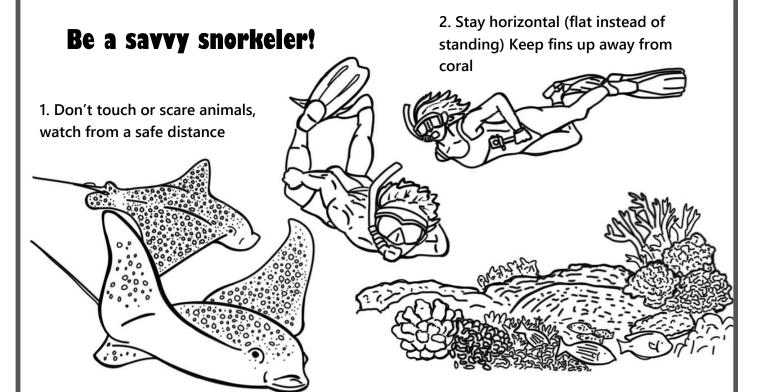


Being a **STEWARD** means taking care of something. In our journey, we've learned a lot of ways to protect our corals, seagrass, and mangrove habitats and the animals that live there.

What are your ideas to protect the ocean? Can you think of ideas to fill in the missing letters of the STEWARD acronym below?



- Snorkel with respect! Do not touch or kick corals, or trample the seagrass.
- Trees, trees! Protecting our forests, mangrove trees, and seagrasses helps keep soil in place so the sediment doesn't get washed onto and hurt corals.
- E-
- **W** -
- Assist our fish! Support our marine preserves and follow fishing and hunting rules.
- R _____
- Do you part! You can volunteer to plant trees, use less plastic, educate others, and more!

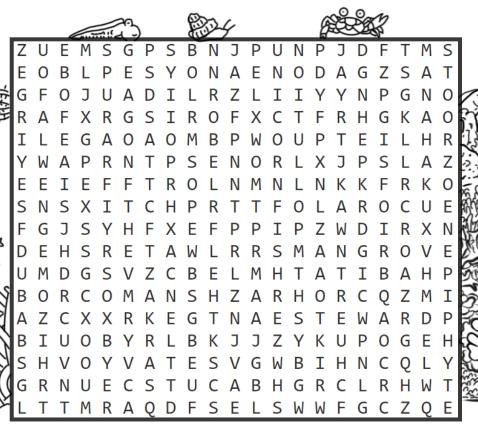


Wrap-up-Word-search



Did you see some new things and learn some new words on our adventure?

See if you remember what these words mean, and find them in the word search.



*Answers on page 27

BONUS!

Habitat Roots HINT: some words may be backwards
Coral Steward and diagonal!

Seagrass Sediment

Mangrove Carbon

Nursery Epiphyte Parrotfish

Rhizome Propagule Pånglao

Erosion Zooxanthellae Nipa

Polyp Pollution Unicornfish

Watershed Preserve Mañahak

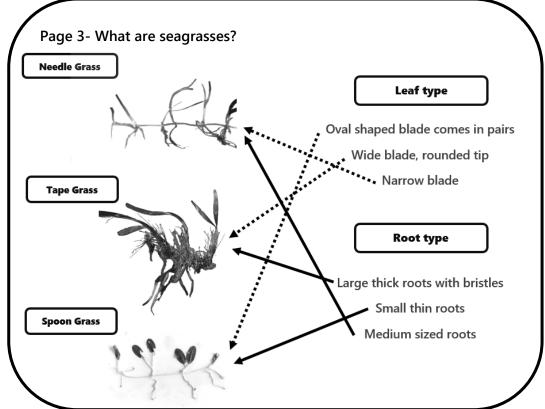
HINT: If you don't remember what a word means, you can go back and look for it, look for words in CAPITAL letters

Answers Pages:



Great job working on these challenges!

Some underlined challenges were creative challenges with many answers, so don't worry if not every challenge has an answer here.



Page 4- Super Seagrass roots!

Top- tape grass

Bottom- spoon grass

Page 6- What is a mangrove?

A= large-leafed orange mangrove

B= red mangrove

C= grey mangrove

Page 12- Growing up in a nursery

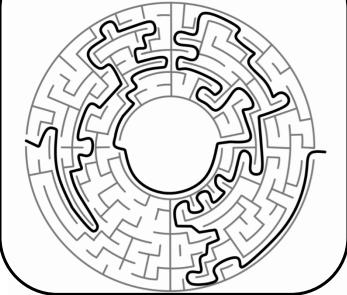
A = streamlined spinefoot

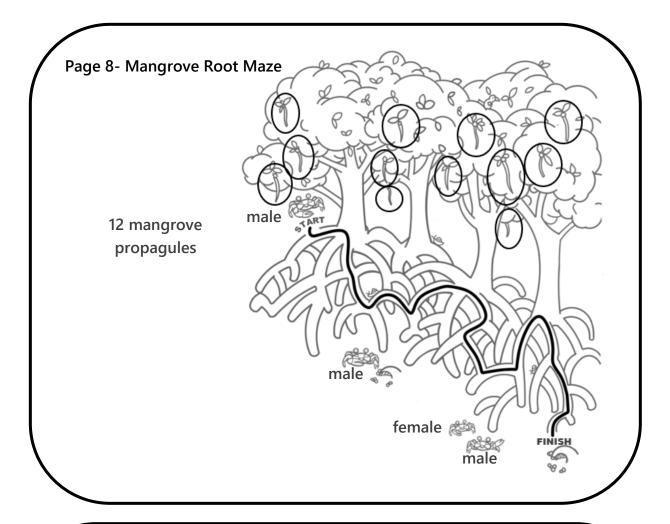
B= barracuda

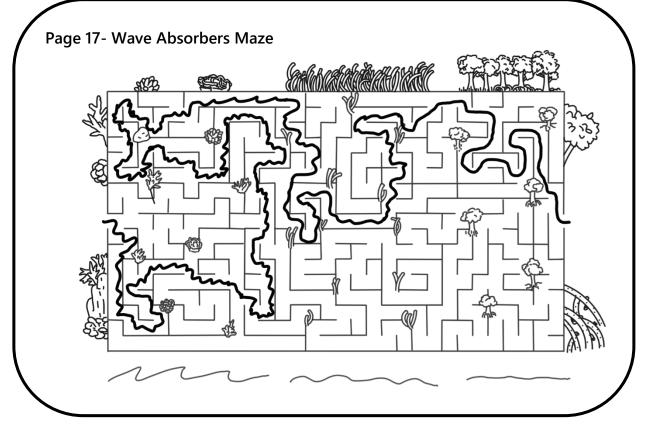
C= Blacktail snapper

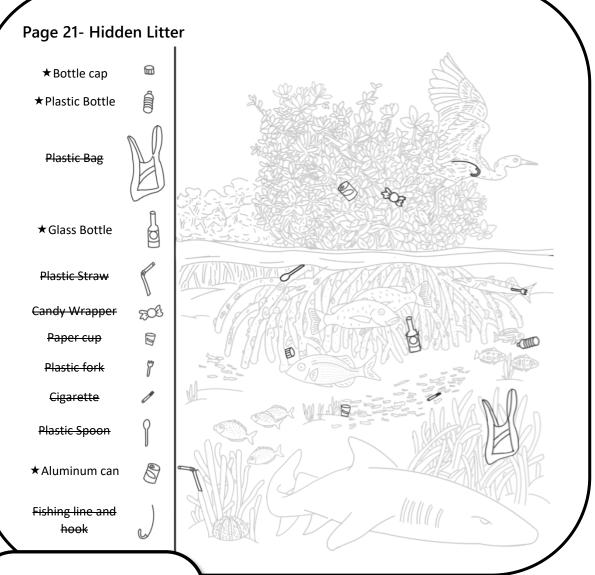
D= Little spinefoot









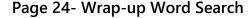


How do I know what I can recycle?

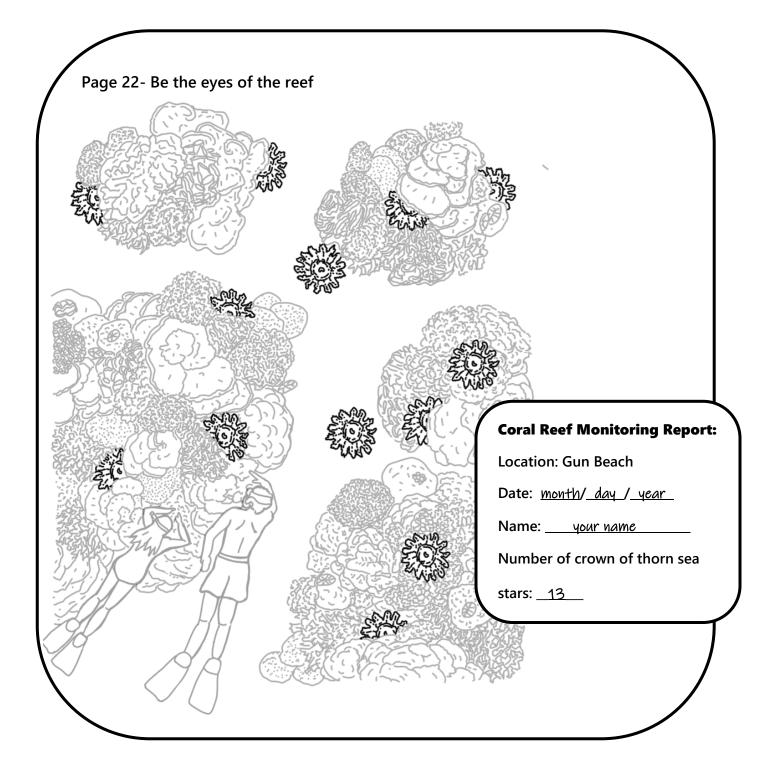
For residential recycling, Guam accepts paper products, metal cans, and plastics #1 and #2 (as of 2023)

There are also special facilities for glass, electronic waste, and chemicals.

Find out more about what you can recycle by checking the Guam Solid Waste Authority website.



ZUEMSGPSBNJP EOBLPESYONAEN DA GZS GFOJUADILRZLI RAFXRGSIROFXC LEGAOAOMBPWO WAPRNTPSENOR IEFFTROLNMN SXITCHPRTTF JSYHFXEFPPI PZWDI DEHSRETAWLRRSMANG UMDGSVZCBELMHTAT BORCOMANSHZARHORC ZCXXRKEGTNAES BIUOBYRLBKJJZYKUPOGEH SHVOYVATESVGWBIHNCQLY GRNUECSTUCABHGRCLRHWT LTTMRAQDFSELSWWFGCZQE



Take-the-Ocean-Pledget



Thank you so much for joining us on our adventure!

As someone living on Guam, YOU have the power to help keep our seagrasses, mangroves, and corals healthy.

By protecting these habitats, you also protect animals and people that live near the water.

Take the pledge by reading and checking off each of the ways you will protect Guam's ocean.



Decorate and color, cut around the edge and on the dotted line to hang it up on a door knob as a reminder!

