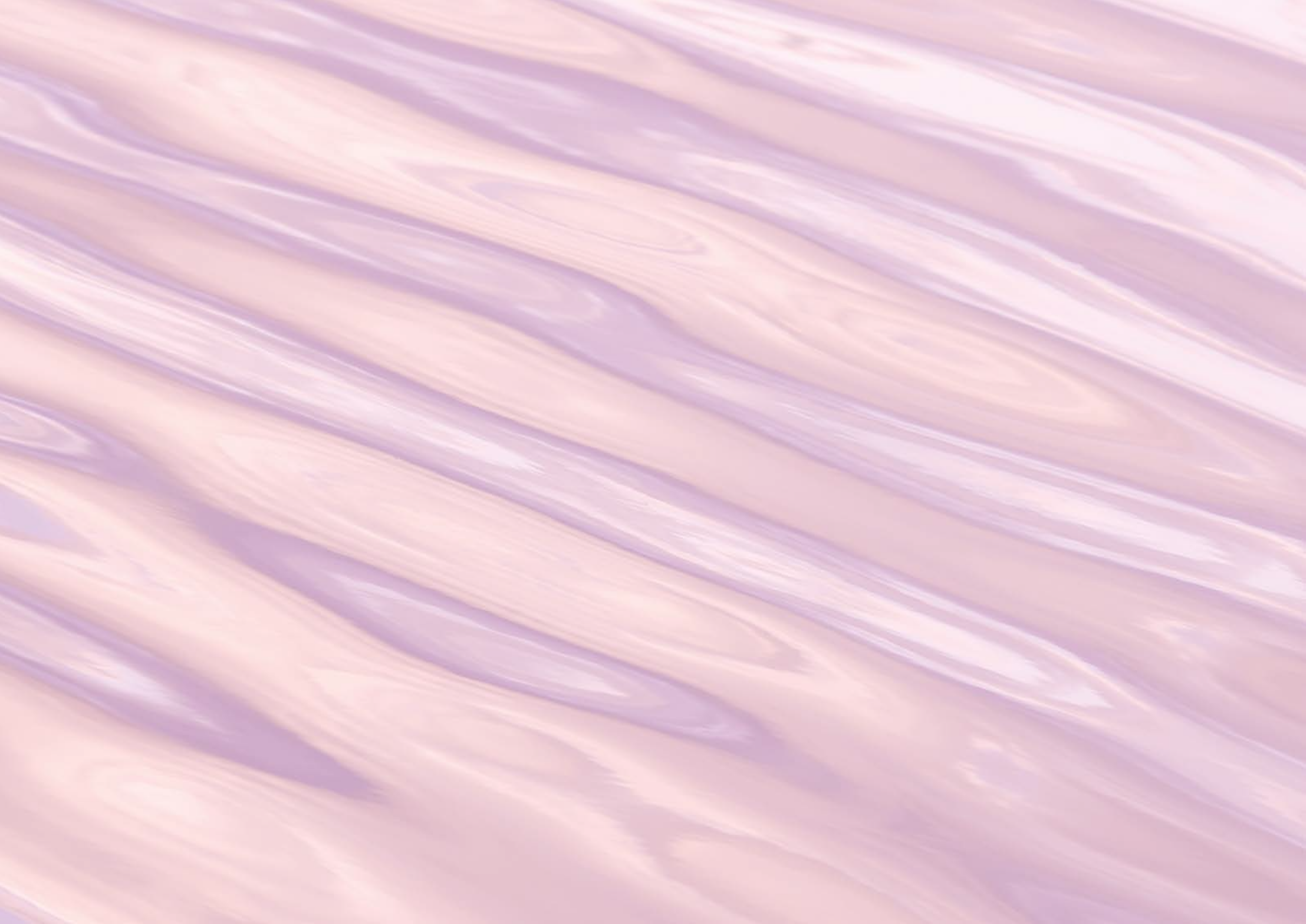


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PACIFIC HIGH ISLAND ENVIRONMENTS

Place-based resources for Pacific Island schools



DEDICATION

*For students, teachers and communities
living in tropical Pacific island environments.*

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INTRODUCTION

There are two main kinds of islands in the Pacific Ocean: high islands and low islands. All islands where people live have some of the same **environments** (kinds of places such as coral reef, open ocean, and forest). Some islands have unique places that are not on all the other islands.

This book describes different environments on Pacific high islands. This book has pictures of these environments, and the plants and animals that live there. See how many of these environments you know about. You can also read the low island book that describes other environments such as the open ocean.

These islands are in the Pacific Ocean near the equator. Because of this location, the islands have a warm **climate**. It is warm for the whole year. It is warm during the day and warm during the night. The ocean is warm all year. This warm climate is different from the climate in many other parts of the planet. Many of the plants and animals that live here are different from the plants and animals that live in colder parts of the planet.

The words that are in purple might be new words in English for you to know. Check out the Glossary near the back of the book where you can learn what each of these words mean. We write these words in purple the first time they are in the book.

This book has pictures of plants and animals that live on low islands. How many of the plants and animals do you already know? What plants and animals do you see on the island that are not in the book? Talk with your friends, family and teachers to find out what they know about the environments, plants and animals on your island home.

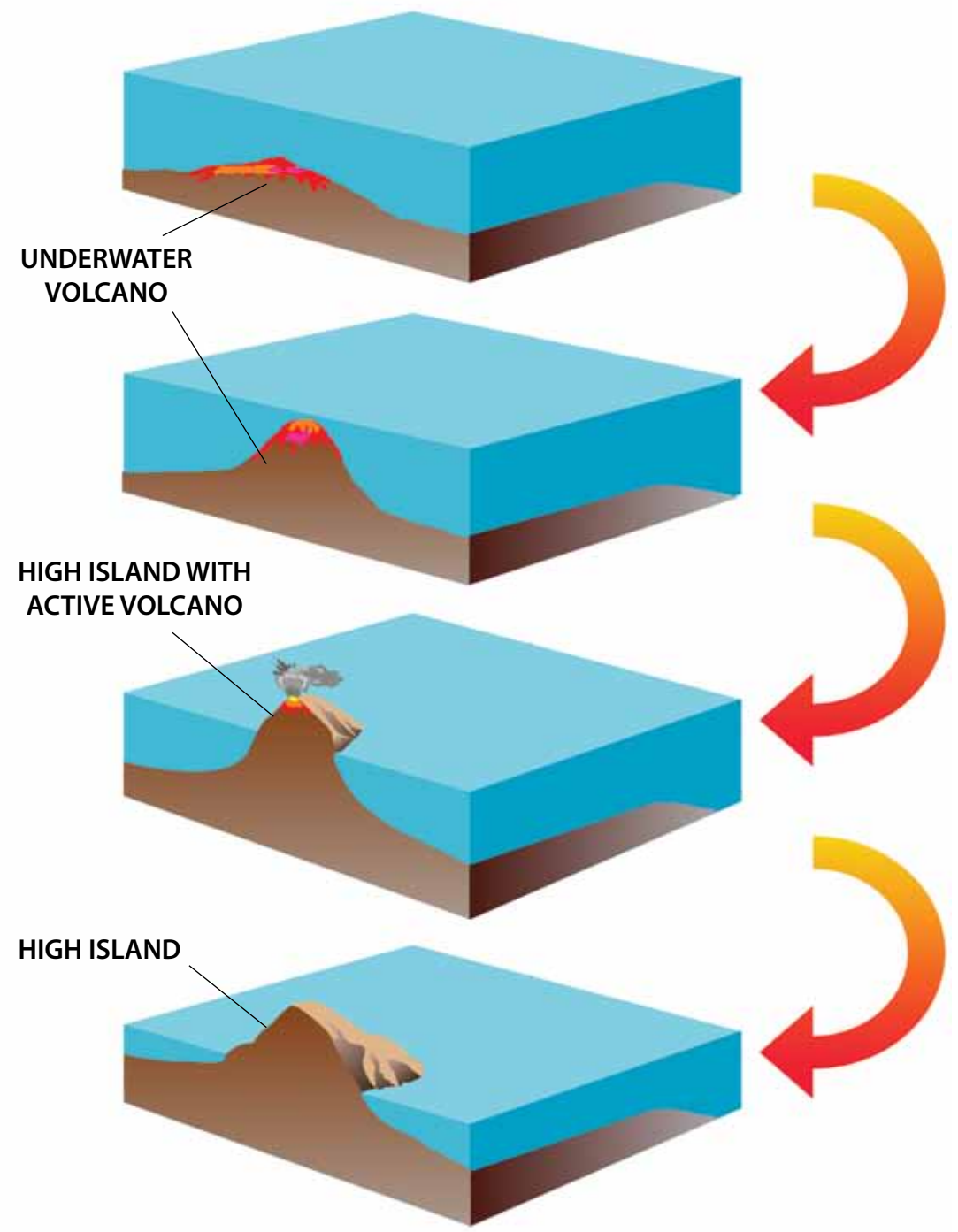
WHAT IS A HIGH ISLAND?

Almost all high islands in the Pacific Ocean that are far from continents started as underwater volcanoes. After hot lava flows from under the ocean into the cool ocean water, the lava changes from liquid to solid, and becomes solid rock. New lava continues to come out and adds more and more rock to the pile. As the pictures show, underwater mountain gradually builds up from the bottom of the ocean, and may eventually reach the ocean surface and become an island.

Additional flows of lava will cause an island to grow more, and rise high above the ocean surface. We call this type of island a high island.

As long as lava keeps flowing, the high island is an active volcano and keeps getting taller and taller. Finally the volcano stops being active and the lava stops flowing. The bottom picture shows a high island that is a volcano that is no longer active, and that has stopped growing in size.

BIRTH OF A HIGH ISLAND



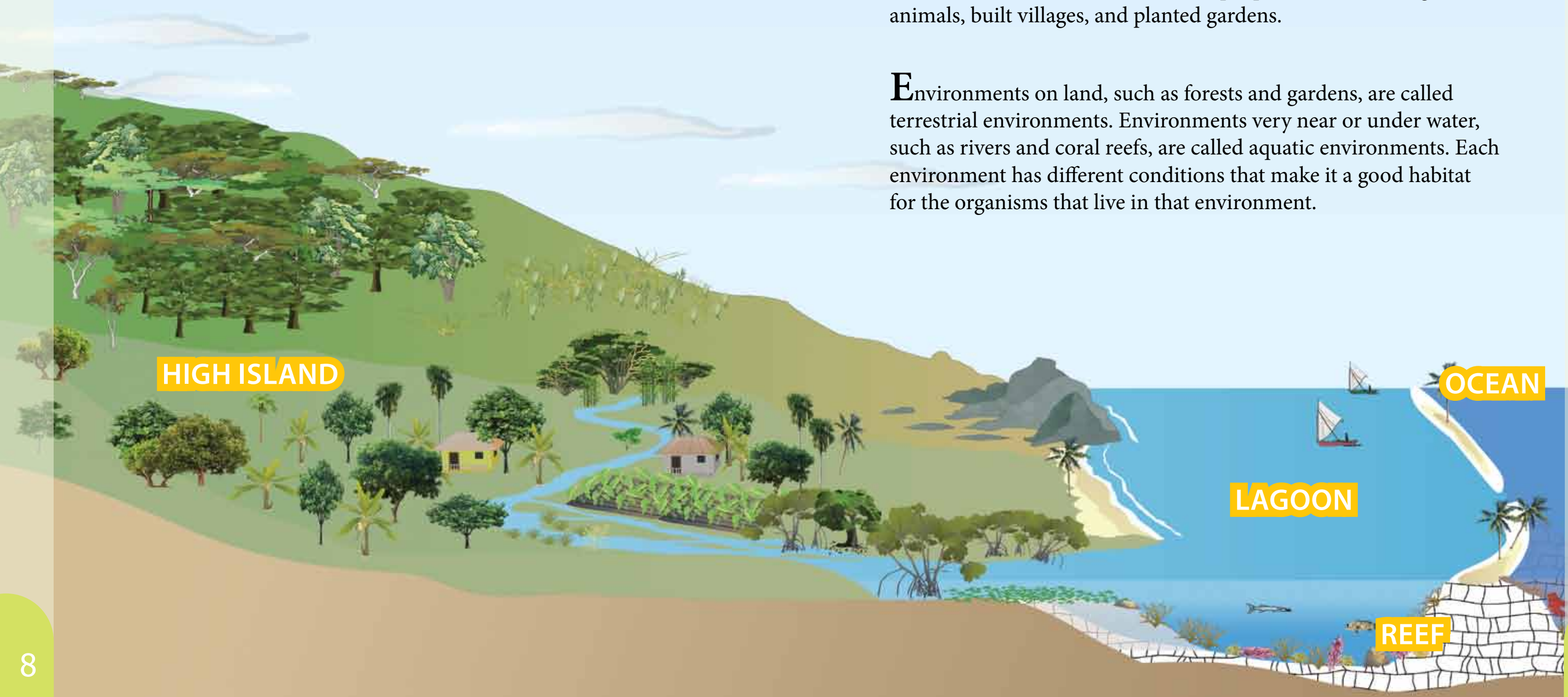
WHAT ARE HIGH ISLAND ENVIRONMENTS?

High islands began without any plants or animals living on them. Over time, ocean currents, wind, and birds brought seeds of plants. Small plants grew in cracks in lava rock, and very slowly made a thin layer of soil. Larger plants and trees grew in this soil.

Birds and bats, attracted by large trees, came flying. Other land animals, such as insects and lizards, arrived on things that float in the ocean such as logs. Along the shores, sand piled up to make beaches. Corals and other **organisms** grew to build reefs. Over time, a shallow water area, known as the lagoon, formed between the land and the reef.

From the mountaintops covered by forest, to the lagoon and reef in the ocean, high islands have many different places that are **habitats** for different organisms. Ancient people traveling in boats discovered these islands. Then more people came and brought animals, built villages, and planted gardens.

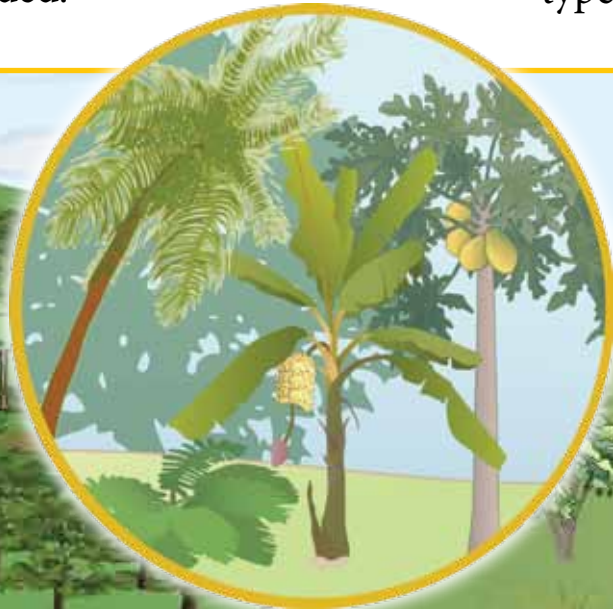
Environments on land, such as forests and gardens, are called terrestrial environments. Environments very near or under water, such as rivers and coral reefs, are called aquatic environments. Each environment has different conditions that make it a good habitat for the organisms that live in that environment.



AGROFOREST

Many high islands in the north Pacific have been inhabited by people for hundreds, or even several thousand years. Ancient people brought breadfruit, taro, pandanus, kinds of coconut, and other plants that they needed.

Over time, contact with people from other islands brought additional useful plants and ways of growing food. These activities have created a kind of man-made forest that is full of fruit trees and other useful plants. Scientists call this type of forest an “agroforest.”



VALLEY FOREST

Many kinds of trees need a lot of water to grow. On islands that do not get lots of rain, trees may have a hard time getting enough water. Trees can grow healthy and strong only in places where the water they need is available to them.

Water at the surface and in the ground always drains toward low-lying areas such as valleys. For that reason, valleys remain wet longer than the surrounding areas that are higher. On most high islands, the valleys through which streams and rivers flow are usually filled with large trees.



UPLAND FOREST

Islands with lots of rain can be covered with large trees all over. An entire island can be one large and healthy forest. However, people often cut forests down. They do so to make space to live and farm, and to get wood for building and burning.

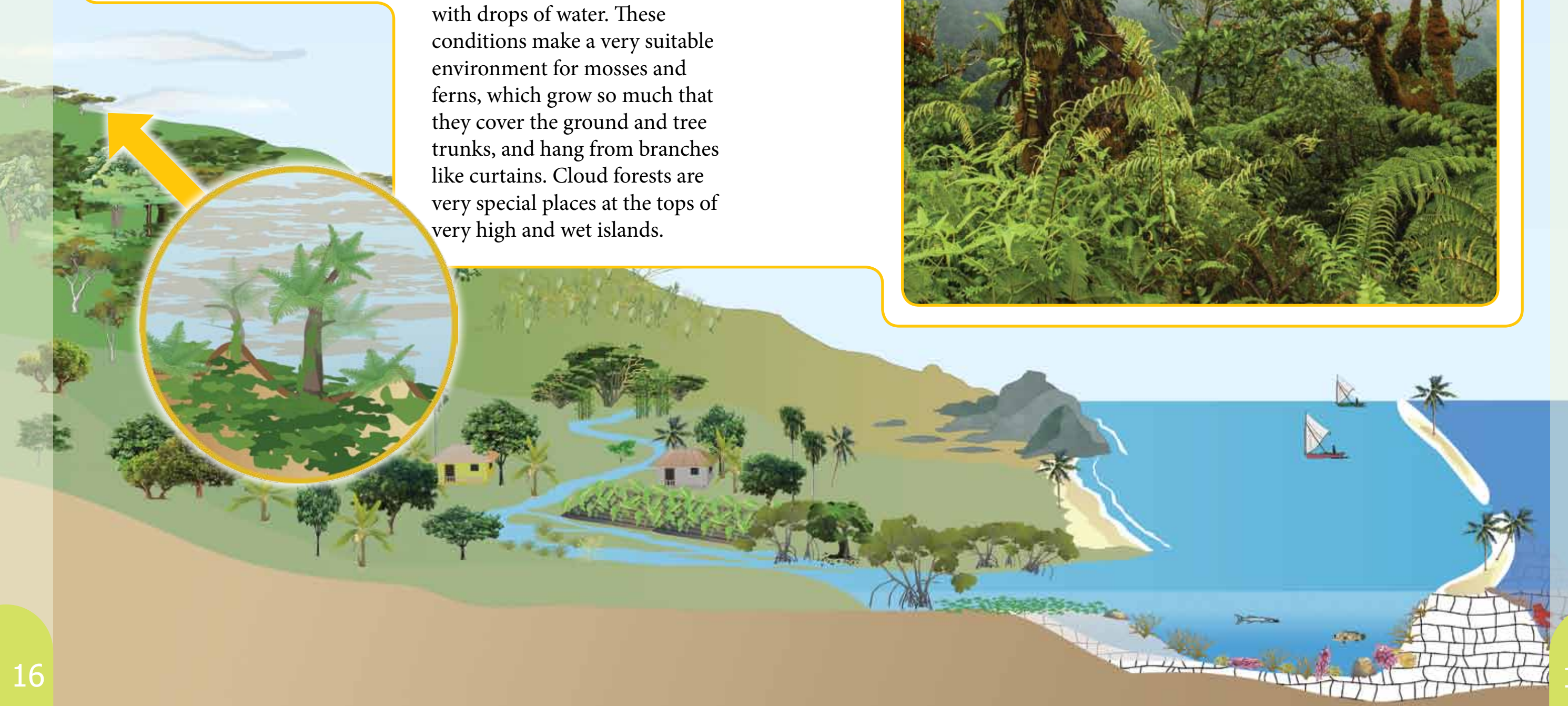
Many Pacific islands used to be covered with beautiful large forests that are now cut down. Large, ancient forests usually survive only in high parts of the island, far from people's villages. Those upland forests have tall, old trees, and many smaller plants. They are home to birds, bats, and other animals. Some organisms that live only in upland forests are endemic – they are not found anywhere else in the world.



CLOUD FOREST

Some islands are very high and humid. They can be so high that the mountaintops are often covered in clouds. The air there is cooler and it rains more than elsewhere on the island.

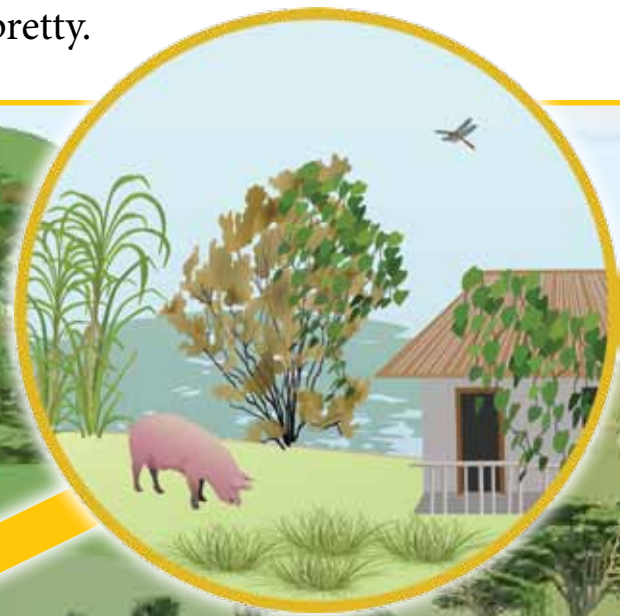
The forest that develops at such heights is very unusual. There are fewer and smaller trees than in other forests because the soil is very thin. The air has so much water evaporated in it that plants are nearly always covered with drops of water. These conditions make a very suitable environment for mosses and ferns, which grow so much that they cover the ground and tree trunks, and hang from branches like curtains. Cloud forests are very special places at the tops of very high and wet islands.



DISTURBED AREAS

Native forests that are cut down by people do not recover quickly. Large, original kinds of trees often do not grow back. Instead, other plants take over the disturbed area. Some of them are trees, bushes, and **herbs** that people plant and look after. Others are wild plants that are allowed to grow because people use them, or simply find them pretty.

There are also many weeds, which grow wild and are not wanted by people. Weeds are usually **non-native** plants that grow in disturbed areas such as clearings, roadsides, rubbish piles, and messy yards. Some weeds are **invasive**: they spread and grow quickly, and can harm the environment.

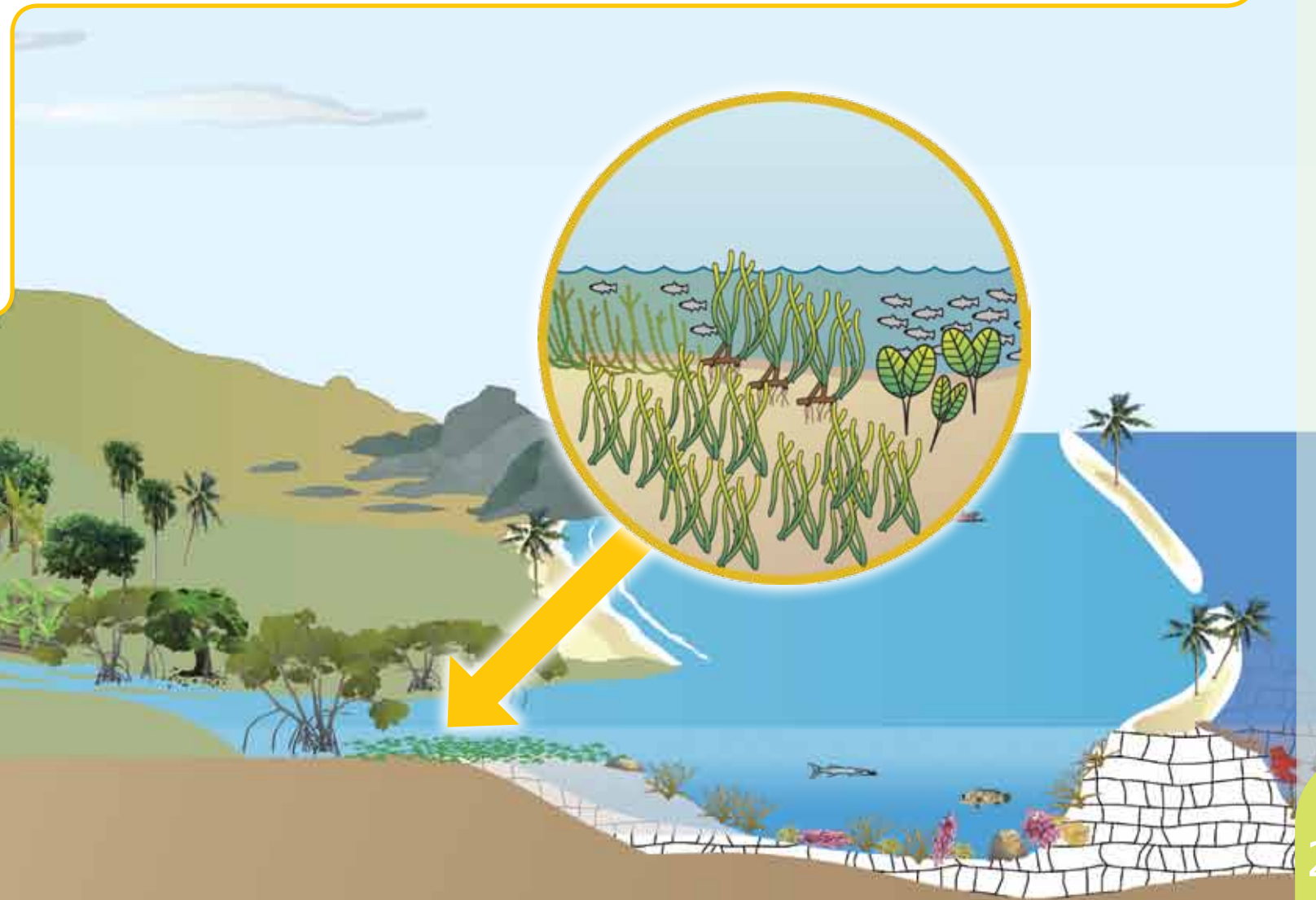


SEAGRASS BEDS



The bottom of the ocean very near land is usually muddy or sandy. It is flat and shallow. At low tide, parts of it become dry. On many islands, such areas are covered by seagrasses. They are known as seagrass beds. Seagrasses are kinds of grass that are **adapted** to grow in salty water.

This special kind of grass is very important because young fish and young **invertebrates** can hide in seagrass beds from bigger fish that would eat them. When they grow up, the fish and invertebrates leave the seagrass beds and move away to deeper places. Seagrass beds are places where young fish and other sea life can grow bigger.



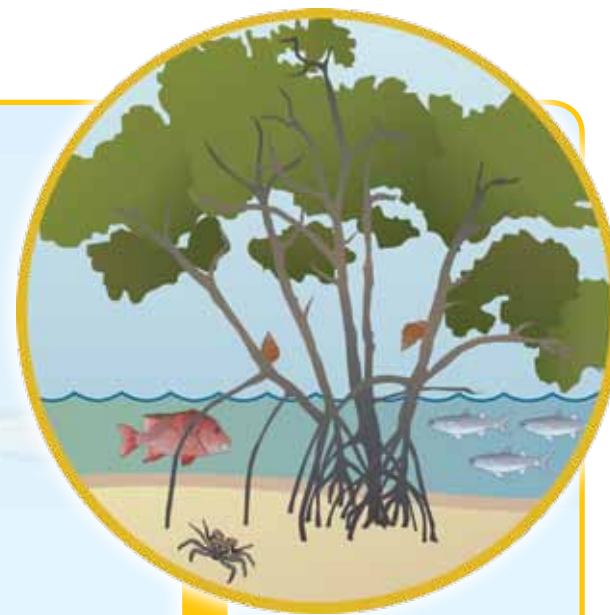
MANGROVE SWAMP



Salt water kills most plants, but mangroves are special trees that have adapted to grow best in salty places where fresh water and ocean water mix.

Mangroves form swamps (flooded forests) between the land and the ocean. Mangrove swamps protect the land from waves and storms. They also protect the lagoon and reefs from mud and sand that is washed off the land. Mangroves have root systems that stop the mud and sand from getting to reefs where they would harm corals.

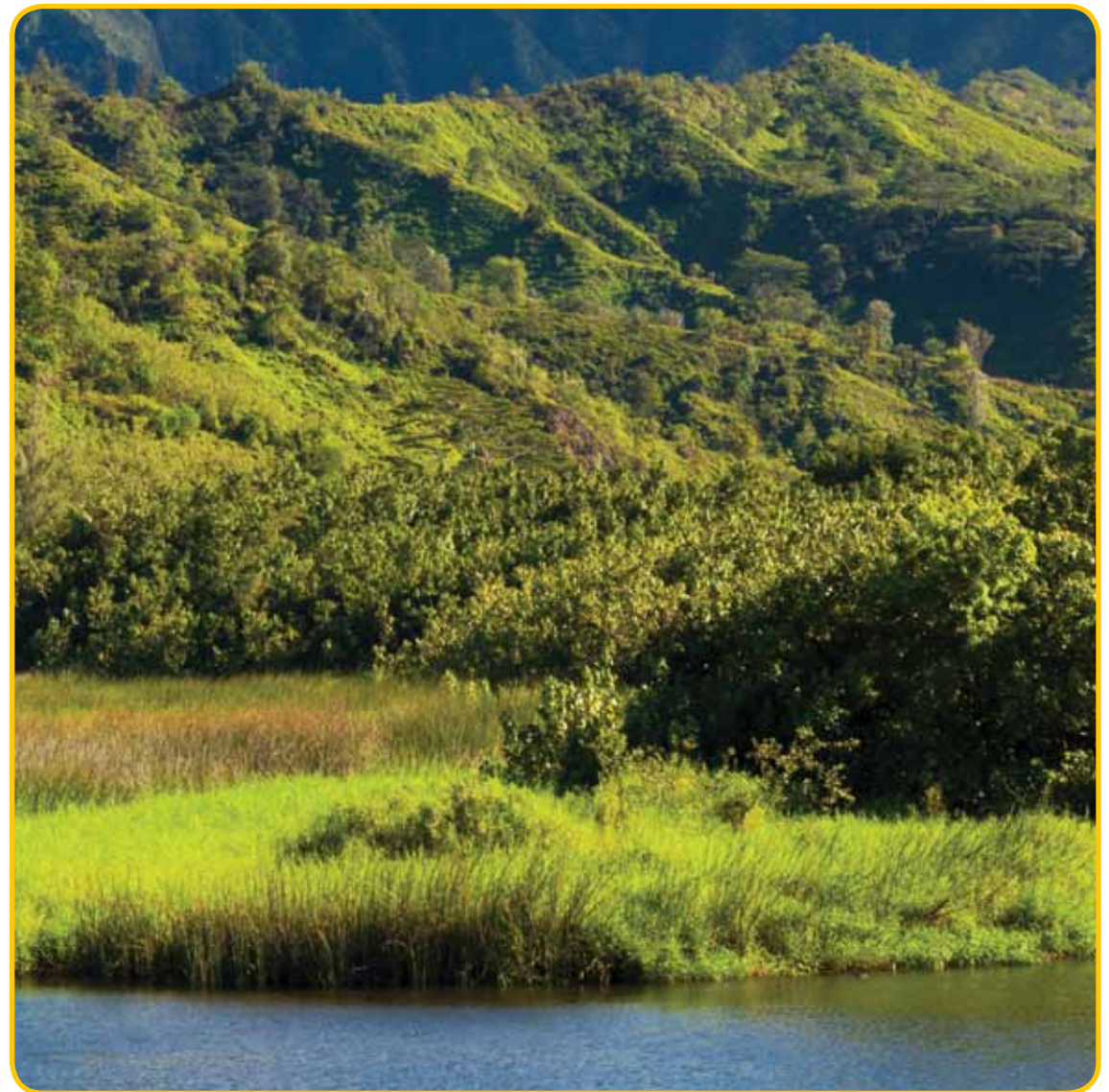
Finally, mangrove swamps are important habitats for crabs, fish, birds, and other animals. Many young fish live safely among the mangrove roots.



WETLAND

Many islands have low-lying areas where water gathers. Such lands are often flooded and nearly always wet. They are called wetlands. Only some plants can grow well under flooded conditions. Various grasses, reeds, and trees are adapted to life in ground that is so wet.

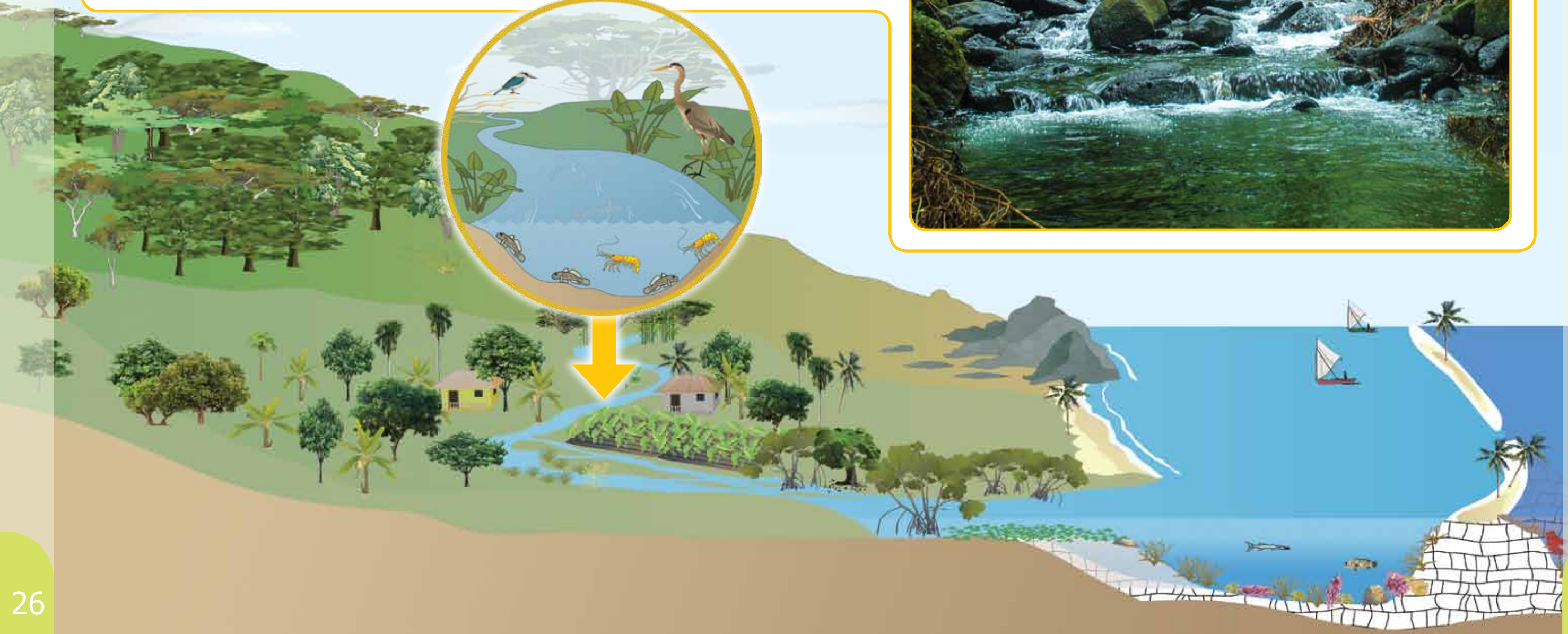
Taro is the best-known and most useful wetland plant in the Pacific. It is one of the most important traditional foods on some islands. Some kinds of taro can grow only in wet areas. People grow it there, turning the wetlands into taro patches. Hiding in shallow water ponds are freshwater fishes, shrimp and crabs, and many water insects. Various birds come to feed on them, and stay in the wetlands.



RIVER

When it rains, the water slowly flows across the land surface. It moves downhill and flows into streams. Streams join other streams and become large streams called rivers. In steep places, rivers are narrow and make waterfalls. In flat places, rivers are wide and flow slowly.

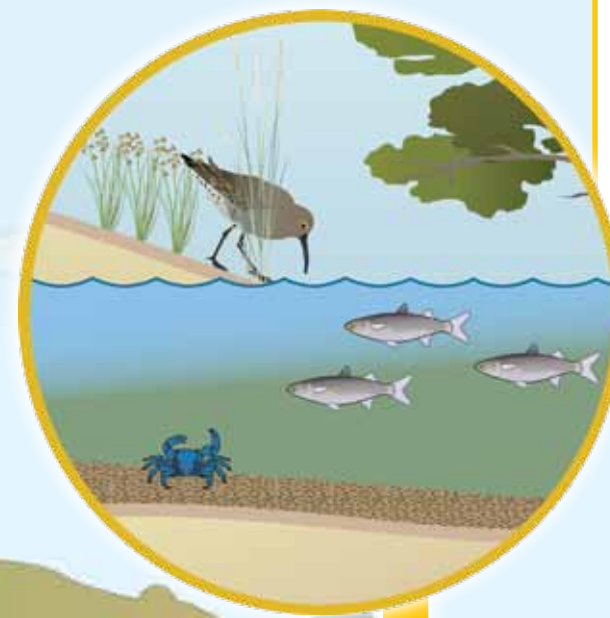
Rivers are habitat for a variety of freshwater organisms, including many fish. Animals that live in fresh water need the rivers and often cannot survive in the ocean. On many islands, people's drinking water supply comes from rivers. It is important that we always keep the rivers clean.



ESTUARY

Rivers flow downhill until they reach the coast, where they bring fresh water into the ocean. The areas where fresh water and ocean water come together near the coast are called estuaries.

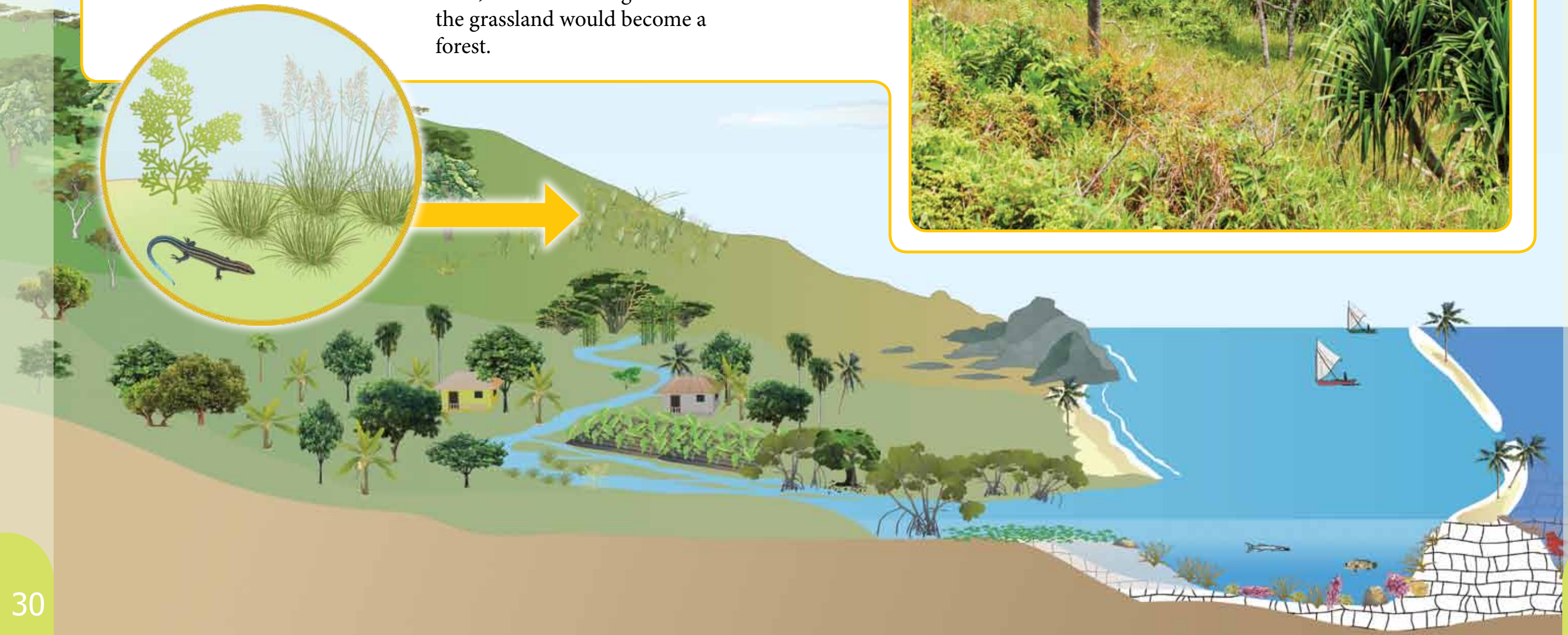
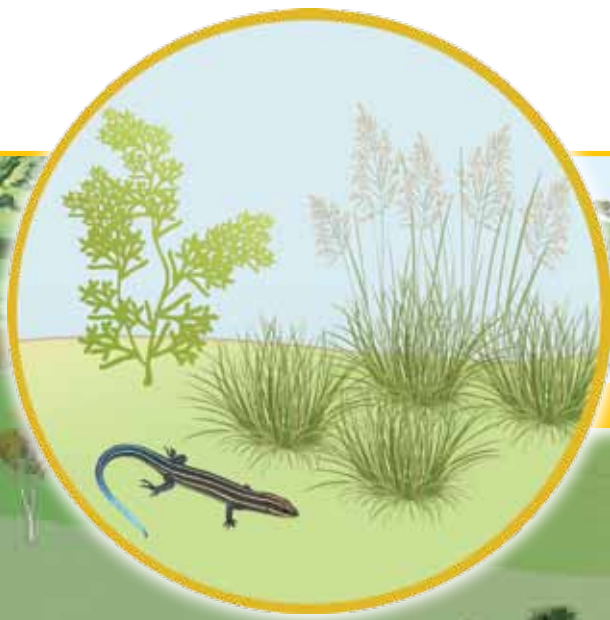
The amount of salt in the estuary water changes with the tide going in and out. The amount of salt in the estuary water also changes with the distance from the ocean. Many fish and other organisms are adapted to the changing amount of salt in estuary water, and can live there. Because the water is usually muddy and rich with food that water washes down from the land, estuaries can have a lot of food for the organisms that live there.



GRASSLAND

Open areas of wild grass, ferns, and bushes cover the land on some high islands. There may be bushes and small trees, especially pandanus, scattered around. Such grasslands are good habitat for many rare bushes and flowers, and certain kinds of insects, reptiles, and birds.

Grasses are not the original plants that naturally grew in these places. Instead, scientists believe that grasslands formed in places where people burned down the forests that used to be there. Repeated fires kill young trees, and grass can grow much faster than new trees. If there are no fires and cutting of trees, then trees will grow and the grassland would become a forest.



KARST

When old coral reefs become dry land, they turn into a type of rock called **limestone**. Limestone **dissolves** in water. It does not dissolve in the rain right away like salt would, but it does dissolve very slowly over hundreds and thousands of years.

Limestone is rare or absent on some islands, especially young volcanic ones, but is very common on others. Some islands are made entirely of limestone. When it rains on limestone islands, water flows into the rocks and very slowly dissolves its way through them. This dissolving of rock helps form **caves**, **sinkholes**, and other features that are known as karst. These dark land locations are habitats for many different animals, such as small insects, bats and birds.



BEACH

Beaches form naturally along many island shores. Places that are protected from large waves tend to have sandy beaches, whereas places exposed to large waves and more wind have rocky beaches.

On Pacific islands, beach sand may come from broken volcanic rocks, in which case it is usually dark colored, or even black. Other sands are made of fine pieces of broken coral and shells of other organisms, and are light colored, or even white. Many small living things hide in beach sand. They become food for crabs and birds. Coconut, naupaka, beach gardenia, and other plants grow closer to the back of the beach. These plants can grow in sandy areas where some salt water blows on them.

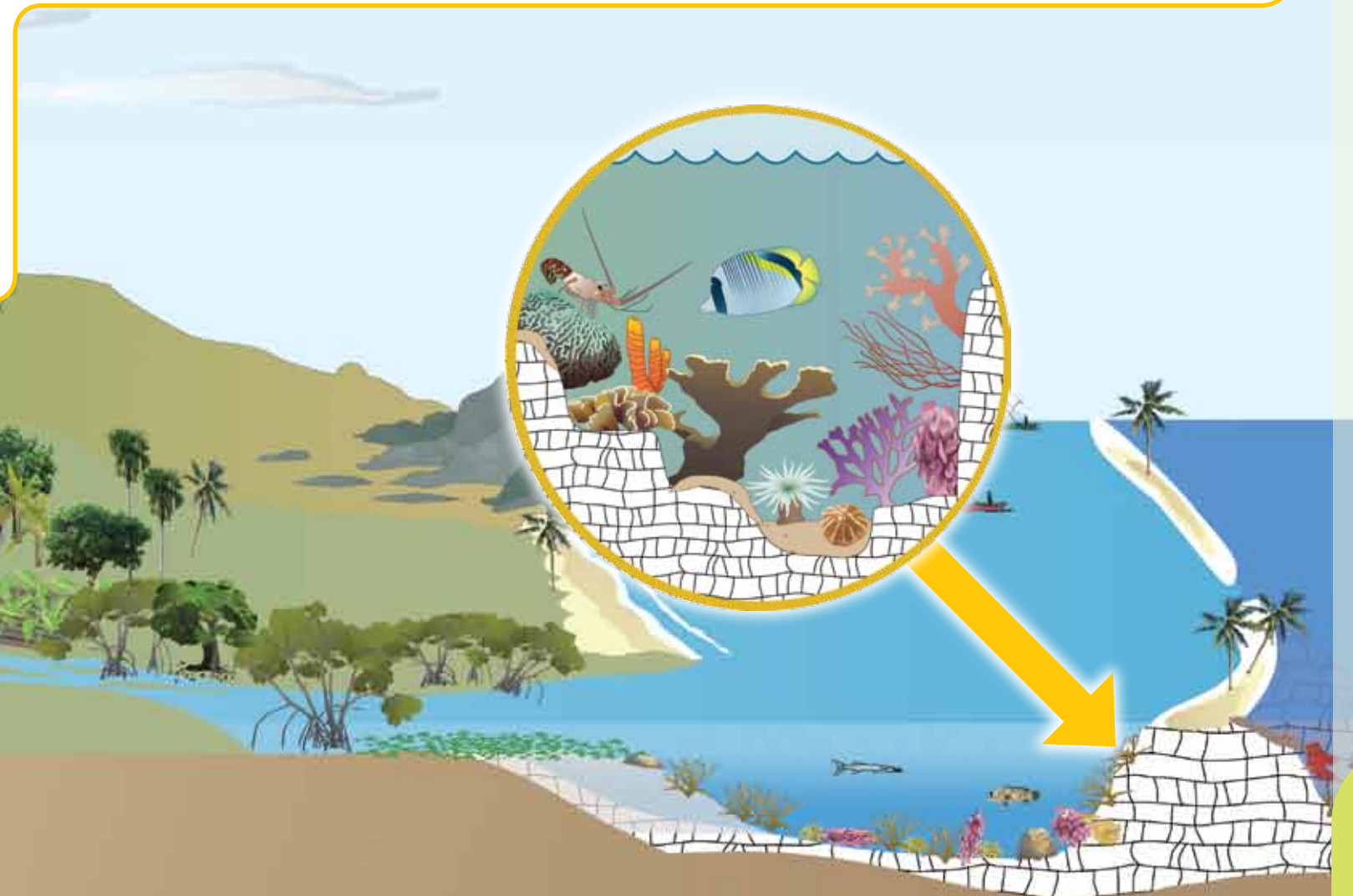


REEF



Coral reefs are large strong structures made by living things in shallow warm waters. They are built mostly by corals and **algae**, but are also inhabited by many other organisms: sponges, sea anemones, worms, clams, snails, sea urchins, sea stars, sea cucumbers, shrimp, crabs, and fish.

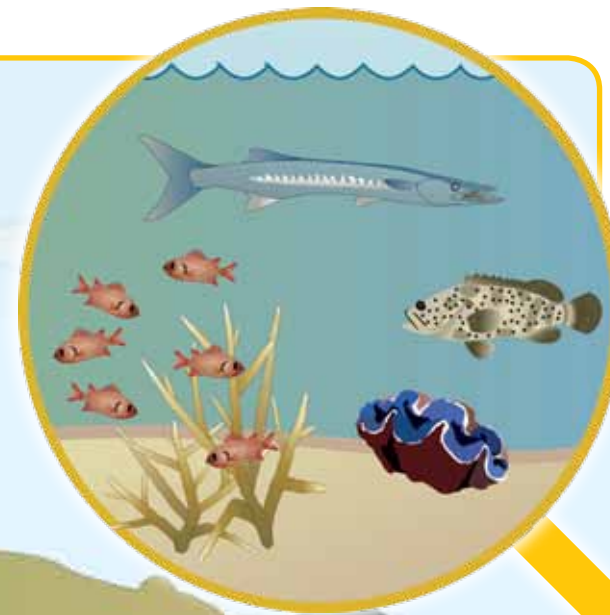
Reefs grow very slowly. The ones we see today around most Pacific islands have been growing for thousands of years. Reefs are important for many reasons. They protect the islands from strong waves and storms. They are an important source of food for people. A greater variety of organisms live on coral reefs than in almost any other place in the ocean.



LAGOON

A lagoon is a naturally enclosed area of the sea, surrounded by land, coral reefs, small islands, and other natural barriers that separate it from the open ocean. Because it is sheltered, the lagoon is quieter than the ocean around it. It is also shallower than the ocean.

The lagoon bottom is covered by **sediment**, which is mud and sand washed off from land, and also broken pieces of coral and shells of other ocean organisms. Because sediments can be different sizes, the bottom in different parts of the lagoon can be rocky, sandy, or muddy. Growing in the sediment can be patches of seagrass or coral. Each different part of the lagoon is a habitat for different fish and other sea animals.



SMALL ISLAND



There are often smaller islands on the reef or in the deeper ocean near high Pacific islands. Such islands may be too small and too far away to be inhabited by people, but they can be wonderful homes to animals.

Seabirds lay eggs and raise their young on these small islands. Sea turtles visit to make their nests in the beach sand. Other animals that people hunt and eat, such as coconut crabs, also find refuge on these islands.



It is important that we do not disturb animals on small islands. Small islands are their last safe places, and they have nowhere else to go.

GLOSSARY

Adapted – having parts of their bodies that help an organism live well in its environment, such as the shell that protects turtles.

Algae – plants that live in water and do not have roots. Some algae have skeletons and help build very strong reefs.

Cave – a natural hole in the land, especially one big enough for people to walk in.

Climate – the kind of weather that a place usually has at different times of the year.

Dissolve – disappear inside water like salt or sugar.

Habitat – a natural home for a plant or animal.

Herb – a small plant that is used to give flavor to food or used as a medicine.

Invasive – a non-native plant that grows fast and spreads into new areas.

Invertebrate – an animal that does not have a backbone such as a clam or a squid.

Lava – very hot melted rock that comes out of a volcano.

Limestone – rock made of remains of shells and skeletons of living organisms.

Native – a plant or animal that lived in a place before people got there.

Non-native – a plant or animal that people brought to an area on purpose (such as pigs) or by accident (such as rats).

Organism – a plant, animal or other kind of living thing.

Sediment – broken pieces of soil, rocks, and shells and skeletons of living things.

Sinkhole – natural hole in the land surface, made by water.



TEACHING TIPS

ISLAND SOILS AND GARDENS

Collaborate with a local expert farmer or island plant manager to investigate which seeds grow best in different kinds of soil.

- Collect four different kinds of seeds from local plants and the Agroforest.
- Label each container with the name of its seeds.
- Collect soil from four different locations, including a sandy beach, and label the soil containers.
- Try to grow each kind of seed in each of the different soils and in the sand. Give each the same amount of water and light.

Observe and keep records of plant growth for all seeds and soils. Include the height of the plant and number of leaves. You can also experiment with starting the seeds by keeping them moist on a towel before planting them in the soil. Make illustrations or graphs to share your results with other students.

Now students can do controlled experiments to investigate the effects of changing the amount of water, light, or different materials added to the soil (such as salt or fertilizer). For each experiment, have students predict what they think will happen (such as how the amount of light will affect the seeds germinating or the plants growing). For each experiment, remind students to keep everything the same except for the one variable they are testing.



CHECK FOR UNDERSTANDING

(adapted from Hiebert & Smith, 2008)

Students use the following check list (e.g., post on the wall, write on the board or hand out individual copies) to self assess their understanding of a word from the glossary (e.g., organisms, habitats) before and after learning its meaning explicitly.

Word (in local language and/or English):	
Meaning:	
Use in a sentence:	
My first understanding... <ul style="list-style-type: none"> <input type="checkbox"/> I have never heard or seen the word before. <input type="checkbox"/> I have heard or seen the word, but do not know what it means. <input type="checkbox"/> I recognize how the word is used in the text and it has something to do with _____. <input type="checkbox"/> I know the word well. 	After learning more about the word... <ul style="list-style-type: none"> <input type="checkbox"/> I am still a little confused about the meaning of the word. <input type="checkbox"/> I know the meaning of the word and understand how it is used in the text. <input type="checkbox"/> I know the meaning of the word and need help from a partner (or teacher) to create different sentences. <input type="checkbox"/> I am confident that I can use the word to create different sentences.

COMPARING ENVIRONMENTS ON HIGH ISLANDS AND LOW ISLANDS

- A.** Have students work in groups to identify two interesting environments on the kind of island on which they live (low or high) and two interesting environments on the other kind of island. Lead a whole class discussion about their choices, and then assign two environments (one from a high island and one from a low island) to each group of students. Try to maximize the number of different environments.

Begin a K-W-L chart with students work in their group to record what they know about their assigned low island environment and high island environment. Fill in the column “What I Know.” Elicit questions that they have about these environments and record under the column “What I Want to Know.”

K-W-L chart		
Topic: _____		
What I Know	What I Want to know	What I Learned

- B.** Have students continue working in the same groups to read about and take notes on the two environments. Make a T chart to record information on the environments on both islands from texts.

Use the T chart to compare an environment on a low island with an environment on a high island. Use details from the book to compare plants and animals in the two environments and their sources of water and food.

T chart	
Topic: _____	
High Island Environments	Low Island Environments

Discuss the similarities and differences between the two environments, using compare/contrast signal words such as “both” and “similar” for similarities, and “different than” and “on the other hand” for differences. Use the word “because” to elaborate and add more details.

Have the students record what they have learned from their readings and discussions under “What I have learned.”

- C.** Have each group of students work to create models of their two environments. The purpose is to represent the nonliving parts of each environment as well as the living parts of each environment. They can use drawings, photographs and words in addition to local materials. Each student group should also prepare to describe their two environments to other students.
- D.** Arrange for students to make presentations about their environment models with each other. After all students have presented, have students write and draw about the similarities and differences between the environments on low islands and on high islands.

PHOTO CREDITS

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OTHER BOOKS IN THIS SERIES

This book is a part of the series, Pacific Islands Climate Education Partnership (PCEP), Place-based resources for Pacific Island schools. The series also includes the following titles published thus far.



Our High Island Home is a book about natural island environments that Pacific children and their families will enjoy reading together. Highly visual images make familiar high island land- and seascapes come to life. Children living on high islands will recognize their everyday world and yet be amazed at the hidden treasures found within.



Our Low Island Home is a book about natural island environments that Pacific children and their families will enjoy reading together. Highly visual images make familiar low island land- and seascapes come to life. Children living on low islands will recognize their everyday world and yet be amazed at the hidden treasures found within.



Pacific Low Island Environments is a book for those wanting to learn more about the places, plants, and animals on tropical low islands in the Pacific. The reader learns how low islands are formed and the various environments that create habitats for many species of plants and animals. From atoll forests to patch reefs and the open ocean, the reader is connected to island life and how important these environments are for the communities that live there.



Mangroves—Living on the Edge in a Changing Climate offers readers of all ages a fascinating journey through the inner worlds of the mangroves. Intricate adaptations and unexpected habitats emerge from the pages of the swamp, unsettling the reader into realizing the incredible value of this island ecosystem. Mangroves provide many resources for local communities, and help reduce global warming by storing more carbon in the soil and its trees than other comparable ecosystems. This book also explains climate change, and how communities can help protect mangroves from climate change impacts such as rising sea levels.



Adaptations—Finding a Fit in the Changing World is a book that children and their families will love. It is full of colorful pictures about how living things are adapted to meet their basic needs in the places they live. Children will be fascinated to learn that some plants have developed chemicals so that animals that share their environment will not eat them. Children will also learn that there are many different types of birds' beaks, all adapted to meet their need for getting food in different places. As children turn these pages, they quickly realize that all living things adapt to get what they need. It is this unique ability to adapt that help all living things survive.



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