EXPLORING THE OCEAN

INDONESIA

OCEANX
Education

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OceanX is on a mission to support scientists to explore the ocean and to bring it back to the world through captivating media. We hope that you'll join us in learning about this amazing environment and the ways that we can engage with it.

The ocean plays an important role in all of our lives. In this book you will learn about:

- ocean science
- creatures that live in the ocean
- tools used in ocean exploration
- ways that you can help to protect the ocean

Let's dive in!

This book belongs to:

Planet Ocean

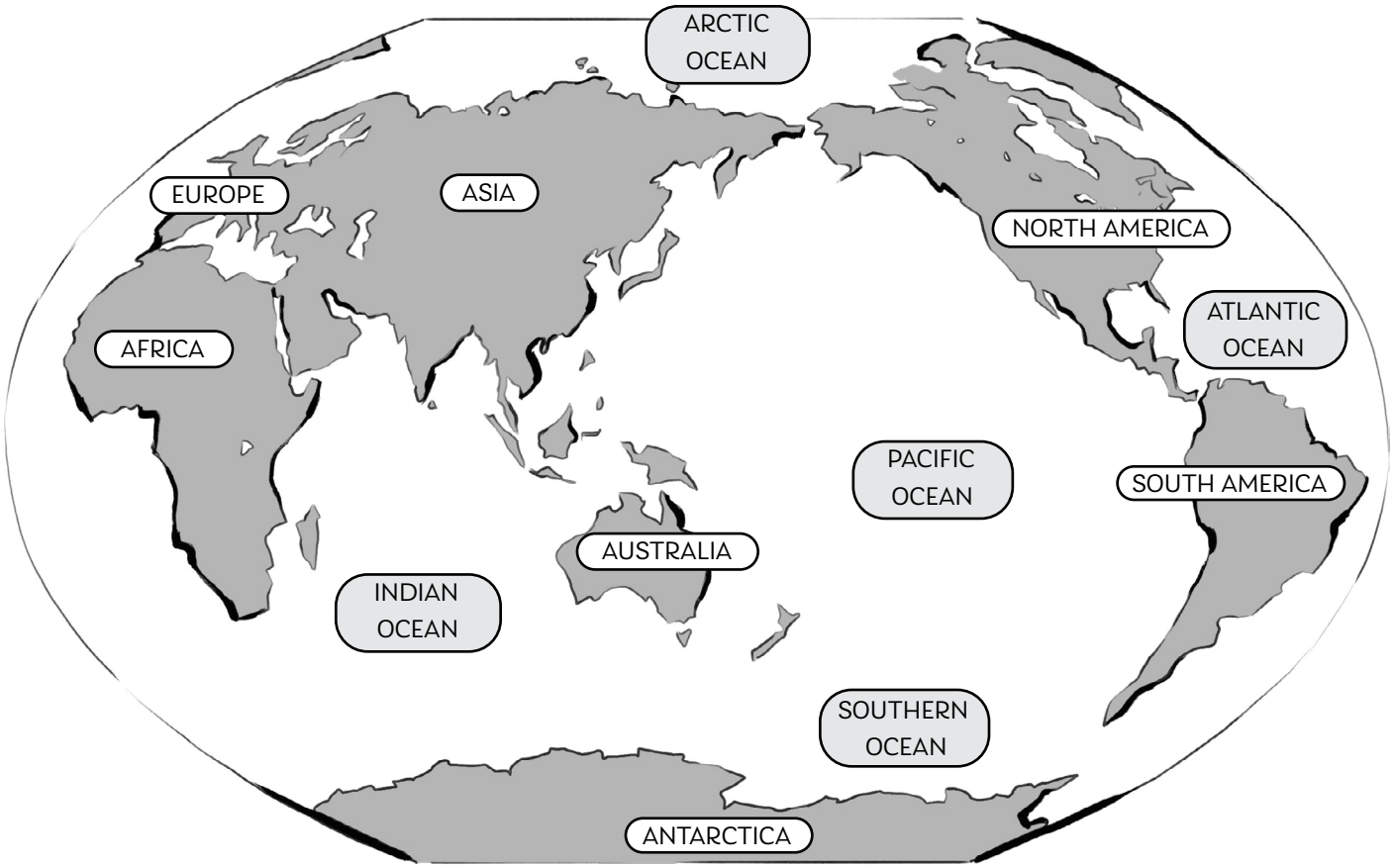
Earth is a water planet.

The ocean is a massive body of salty water that covers over 70% of the Earth's surface! The ocean is essential to all life on Earth. The ocean is connected, but we divide the ocean into five different basins:

- Pacific Ocean
- Atlantic Ocean
- Indian Ocean
- Arctic Ocean
- Southern Ocean

Interesting Ocean Facts:

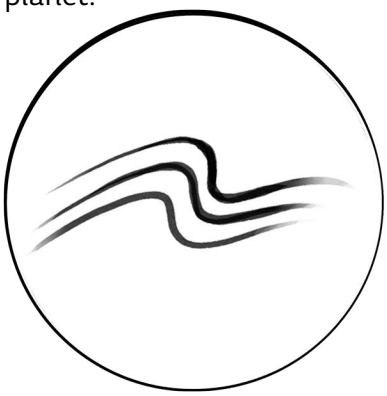
- The Pacific Ocean is the largest of the ocean basins, covering about 30% of the Earth.
- The deepest part of the ocean is the Mariana Trench. Its deepest point is about 11 kilometers deep.
- The longest mountain range in the world is found underwater. It is called the mid-ocean ridge and is over 16,000 kilometers long.
- If all the salt was removed from the ocean and poured on the continents, it would cover them all to a depth of 152 meters.



The Ocean Impacts Us All

The ocean is home to fish, mammals, birds, reptiles, bacteria, fungi, and more. Humans depend on the ocean for food, transportation, jobs, culture, and our everyday lives.

The ocean absorbs heat from the Sun and moves it around the planet through currents. Without the ocean, the Earth would be much hotter and have less oxygen in the atmosphere—we have the ocean to thank for regulating our climate. Protecting the ocean means protecting the future of our planet.

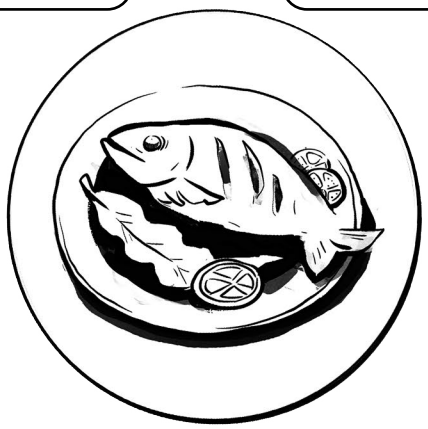


The air we breathe

Climate regulation

Transportation

Recreation



Food

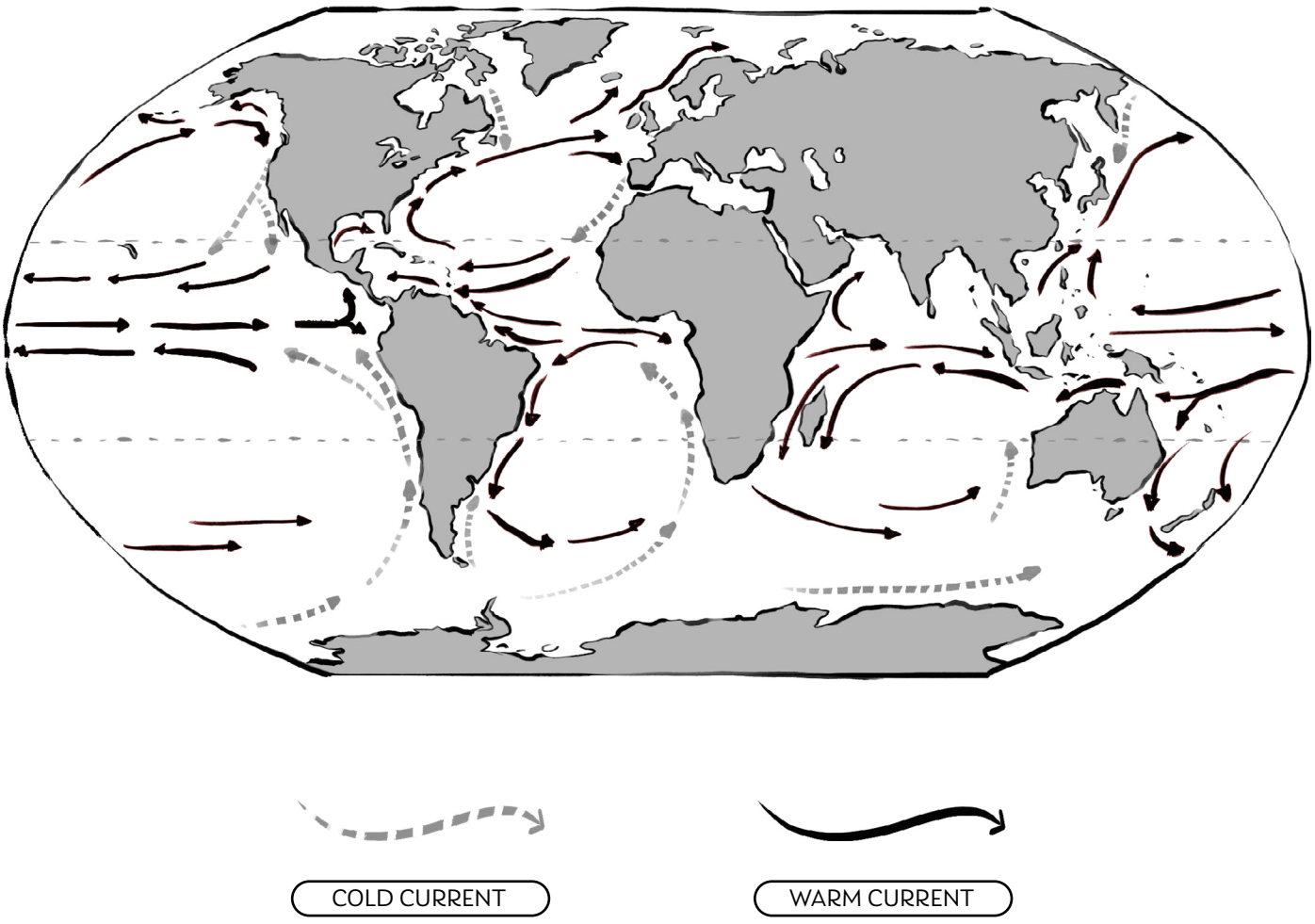
What are some other ways that you interact with the ocean?

Ocean Waves, Currents, and Tides

In the ocean, water is constantly moving. On the surface, water moves in the form of waves, which are caused by wind pushing water across the surface of the ocean.

Below the surface, ocean currents are continuous flows of water that transport heat around the world. Ocean currents are caused by four main factors:

- Wind
- Earth's rotation
- Density differences caused by temperature and salt content
- Gravity from the moon and the sun



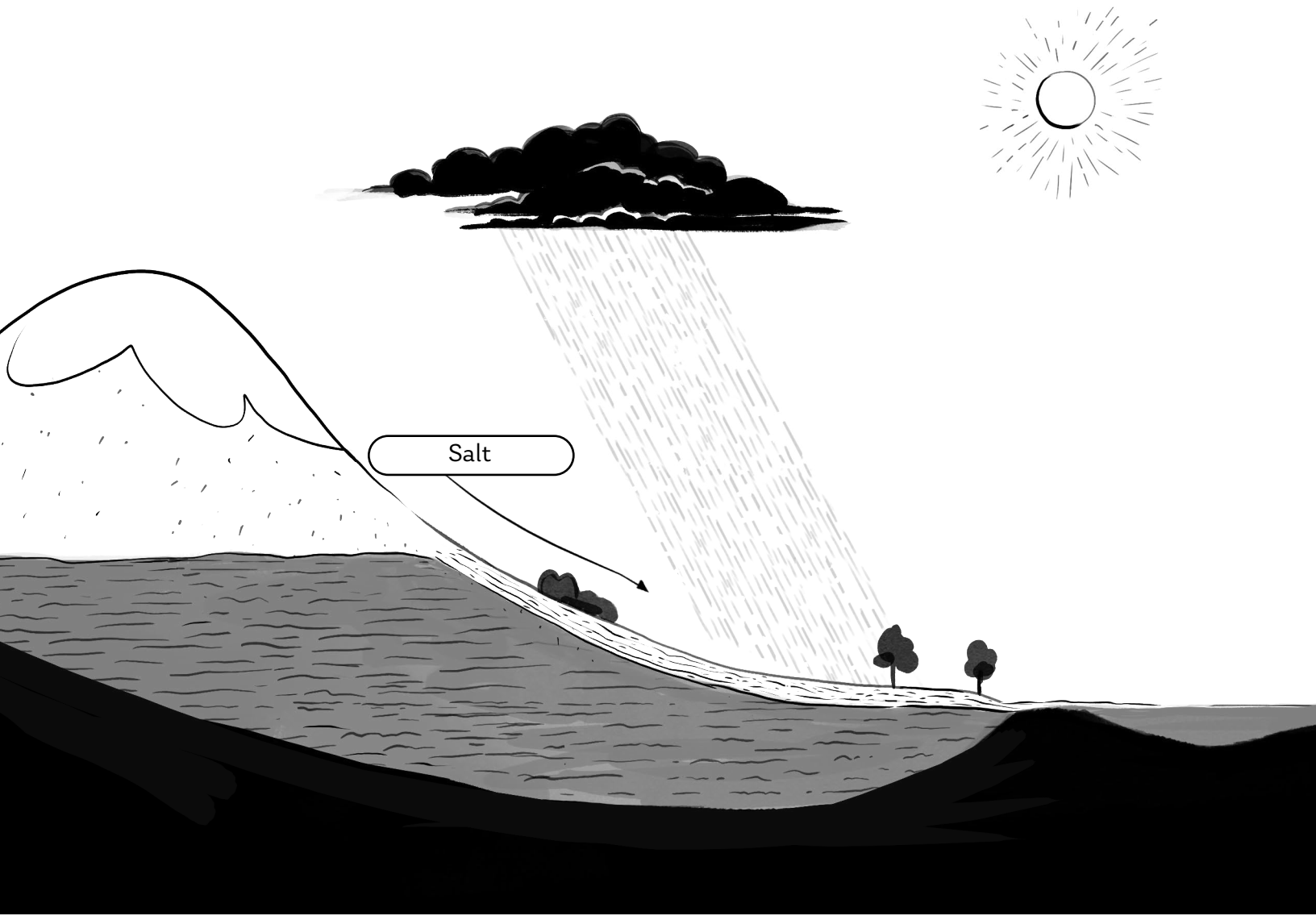
Chemical Oceanography

What is Water?

Water is essential for all life. Water can exist in many forms, including solid (like ice), liquid (like the water we drink), and gas (like steam). Because water can exist in these different forms, it can then form precipitation (rain, hail, and snow), clouds, and water vapor. Water also can dissolve more substances than any other liquid and can absorb a lot of heat, making it incredibly important to the way our planet functions.

Why is the Ocean salty?

The ocean is salty because rocks and minerals (such as salt) on land are eroded by water and transported by rivers to the ocean. These salts and minerals accumulate in the ocean over millions of years, making saltwater. Approximately 97% of the water on Earth is the saltwater in our ocean, which means that only about 3% of the water on Earth is freshwater, made up of ice, glaciers, lakes, rivers, groundwater, and other surface waters.



Why Ocean Exploration Matters

There is so much more to learn about the ocean! Most of our ocean is underexplored and not well understood. More than 90% of the ocean has not been explored. There are so many discoveries waiting to be made!

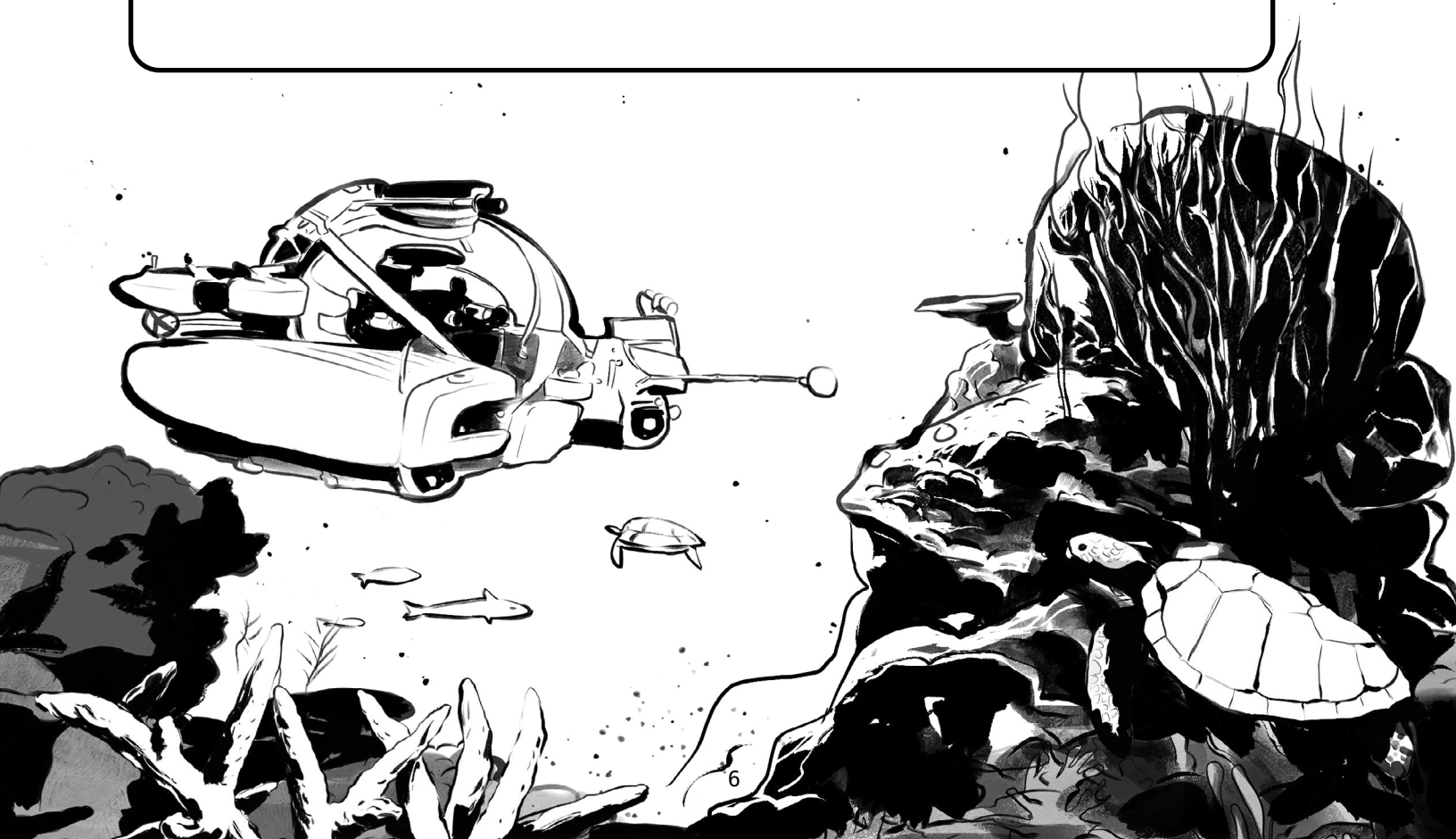
- What animals might live in the unexplored parts of the ocean?
- What sorts of underwater environments are in the deepest parts of the ocean?
- Can you imagine what undiscovered ocean plants might look like?

Studying the ocean is also important for understanding how we can best manage, protect, and conserve the planet's resources. It also can help us understand how we are changing the ocean.

Understanding the deep ocean and extreme habitats will help us to understand life and oceans on other planets.

Exploring the deep can help us develop new innovative technology that can withstand the extreme pressures and temperatures of the deep ocean.

What parts of the ocean do you want to explore?



Ocean Mysteries

The ocean is vast and mysterious, and there is still so much we don't know. Below are just three unsolved mysteries of the ocean.

What causes the Milky Sea Phenomenon?
In the Indian Ocean and in Indonesian seas, mariners have been reporting "milky seas" for centuries. These milky seas are huge patches of glowing bioluminescence that cover miles and last for long periods of time. Bioluminescence is light created by living creatures using a chemical reaction to make their bodies glow, like a firefly. The nature, function, and extent of bioluminescence is still not well understood.

How do "Immortal jellyfish" regenerate?
The Immortal Jellyfish (*Turritopsis dohrnii*): The immortal jellyfish is a small jellyfish found in warm waters that has a special capability that most creatures lack. When the immortal jellyfish starts to die, it sinks to the ocean floor and dissolves itself into a blob of cells, which will become new baby jellyfish. This incredible ability is still not well understood and is an important discovery for science.

Who is the Mystery Whale?
Scientists have recorded calls from one whale that are recognizable because of its very unusual high pitch and high frequency (52 hertz). These calls do not match any other whale species and have been recorded in many places around the world since the 1980s. No one has ever seen this mystery whale. Its migration track is unrelated to that of other species. Scientists hope to find this mystery whale.

What other Ocean Mysteries can you think of?

Meet the OceanXplorer

The OceanXplorer research vessel was built to help OceanX explore the ocean and bring it back to the world. It provides access to advanced research tools including submersibles, robots, SCUBA gear, a helicopter, and sampling tools.

There are many laboratories, including:

- The wet lab, where scientists test and analyze samples
- The dry lab, where scientists analyze environmental DNA (eDNA)
- The media lab, where the media team creates and edits film and photos

The OceanXplorer serves as home for scientists, crew, and guests, for up to months at a time. You will find bedrooms, lounges, and a dining hall on board. When the crew is not hard at work, you may even find them playing basketball on the back deck!

SCUBA

SCUBA is an acronym that stands for Self-Contained Underwater Breathing Apparatus—the equipment that divers use to breathe underwater. SCUBA divers use a large metal tank filled with compressed air, a regulator for breathing air from the tank, a mask to see through, a snorkel to breathe at the surface, fins to swim better, and a wetsuit to keep them warm underwater.

Jacques Cousteau was a French ocean explorer, oceanographer, and filmmaker who co-invented the first SCUBA diving equipment, called the Aqua-Lung, in 1942. The Aqua-Lung helped make it possible for Jacques to produce the first underwater films.

Where would you SCUBA dive?

Submersibles

Submersibles are underwater vehicles designed to take people down in the ocean's depths. Unlike SCUBA diving, people using a submersible stay in a dry compartment and can breathe without a mask.

Each of the submersibles used on the OceanXplorer can hold three people. One person is the pilot, who is responsible for controlling the vehicle. The other seats are typically taken by scientists or filmmakers. Submersibles are used around the world by oceanographic explorers and researchers.

The submersibles on the OceanXplorer are named Nadir (which is designed to carry cameras and film equipment) and Neptune (which is designed to take scientific samples). These submersibles can go down 1,000 meters.

In the picture below, the seats next to the pilot are currently empty. Who would you want to go exploring with?

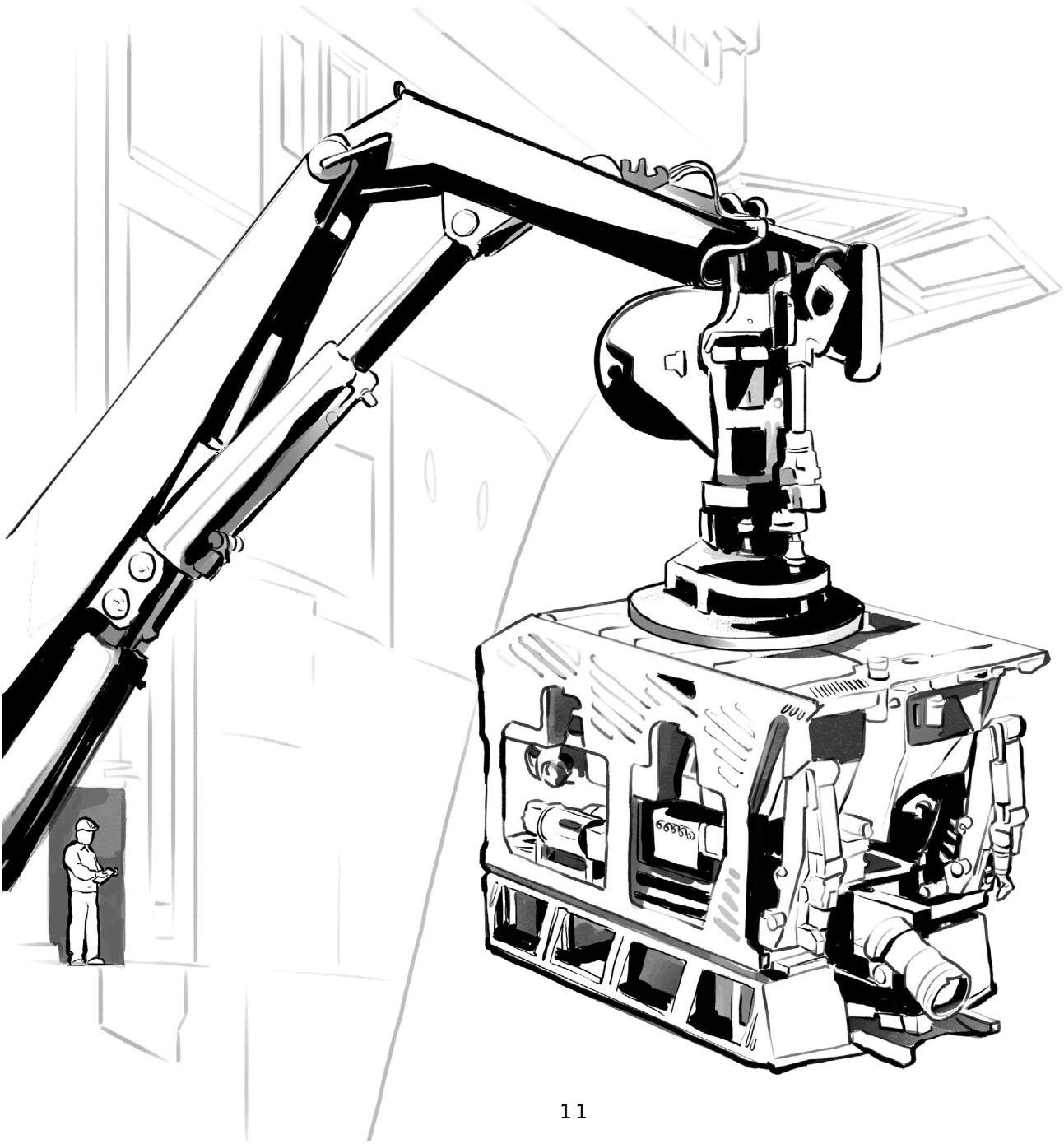
Draw yourself and your exploration buddy in the empty seats.

ROV

ROV stands for Remotely Operated Vehicle. ROVs are robots that are used to take videos and photos and sample underwater environments. Unlike a submersible, people cannot ride in an ROV, and thus the ROV does not have human life support systems on it. This means that the ROV can stay down in the ocean longer than a submersible and go places that would be dangerous for humans.

The ROV on the OceanXplorer is named Chimera and can go down 6,000 meters. (Since 96% of the planet's ocean is 6,000 meters or shallower, this ROV can explore in almost any place that the OceanXplorer could travel to.)

The ROV is connected to a cable on the ship that helps to lower down the ROV into the ocean. The ROV is driven and operated by a person onboard the ship. On the ROV are cameras, bright lights, and manipulator arms. The ROV moves with its thrusters that propel the ROV through the water.

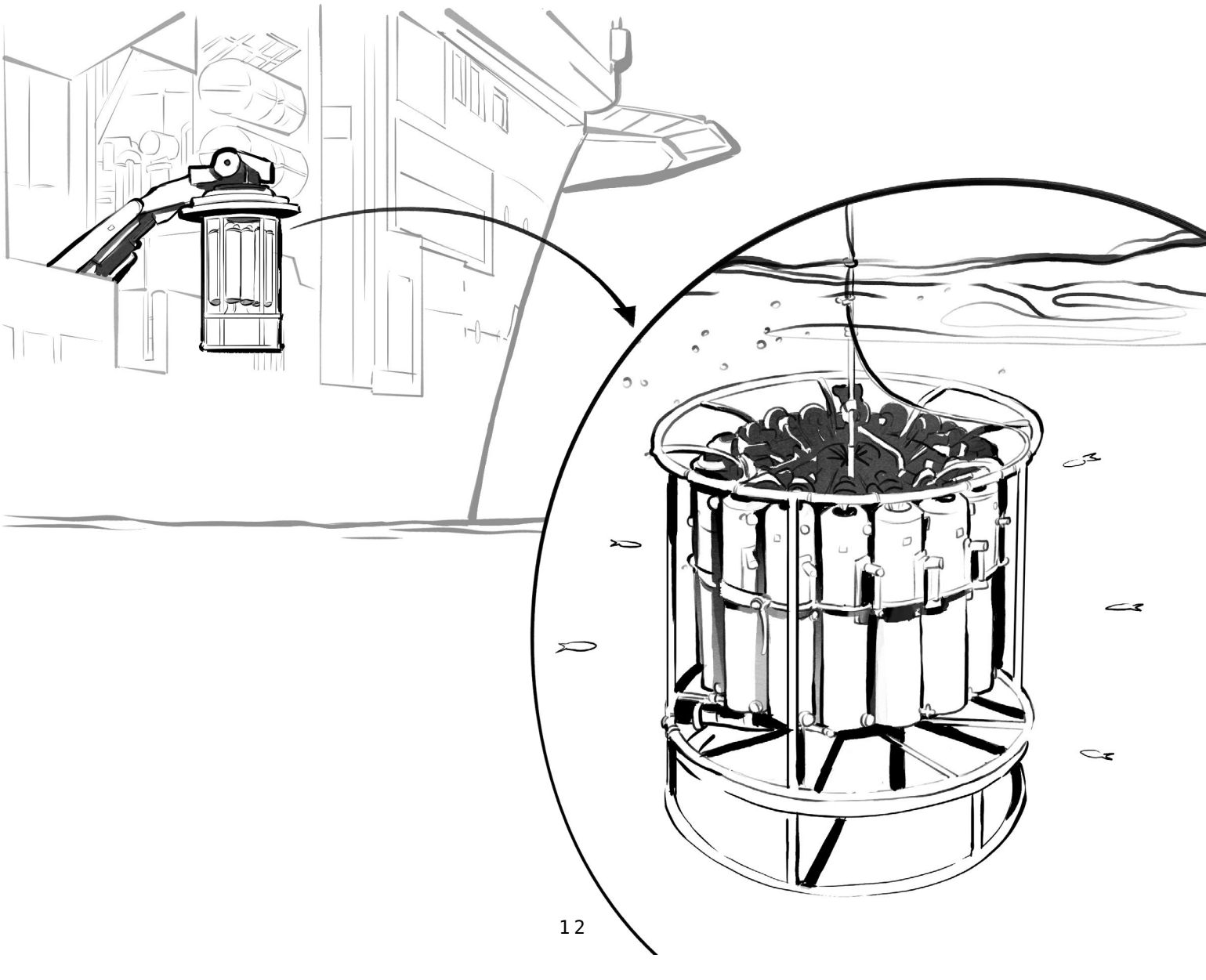


CTD

One of the tools scientists use to understand the water in our ocean is a CTD profiler. CTD stands for Conductivity, Temperature, and Depth.

- Conductivity is a measure of how much electricity can be conducted through a substance, and is directly related to the salt content, or salinity, of water.
- The temperature of the water is measured, and when combined with the salinity, we can calculate the density of the water, which tells us more about currents.
- By combining this information with the depth that the data is taken, we can build a vertical (up and down) set of data about the properties of water in a certain location.

The CTD profiler has a large metal frame that holds sampling bottles. On a mission, the CTD profiler can be sent down deep into the ocean, attached by a signal cable. As the CTD slowly returns to the surface, it can be programmed to open individual bottles at different depths along the way. This allows for water data to be collected at multiple points.



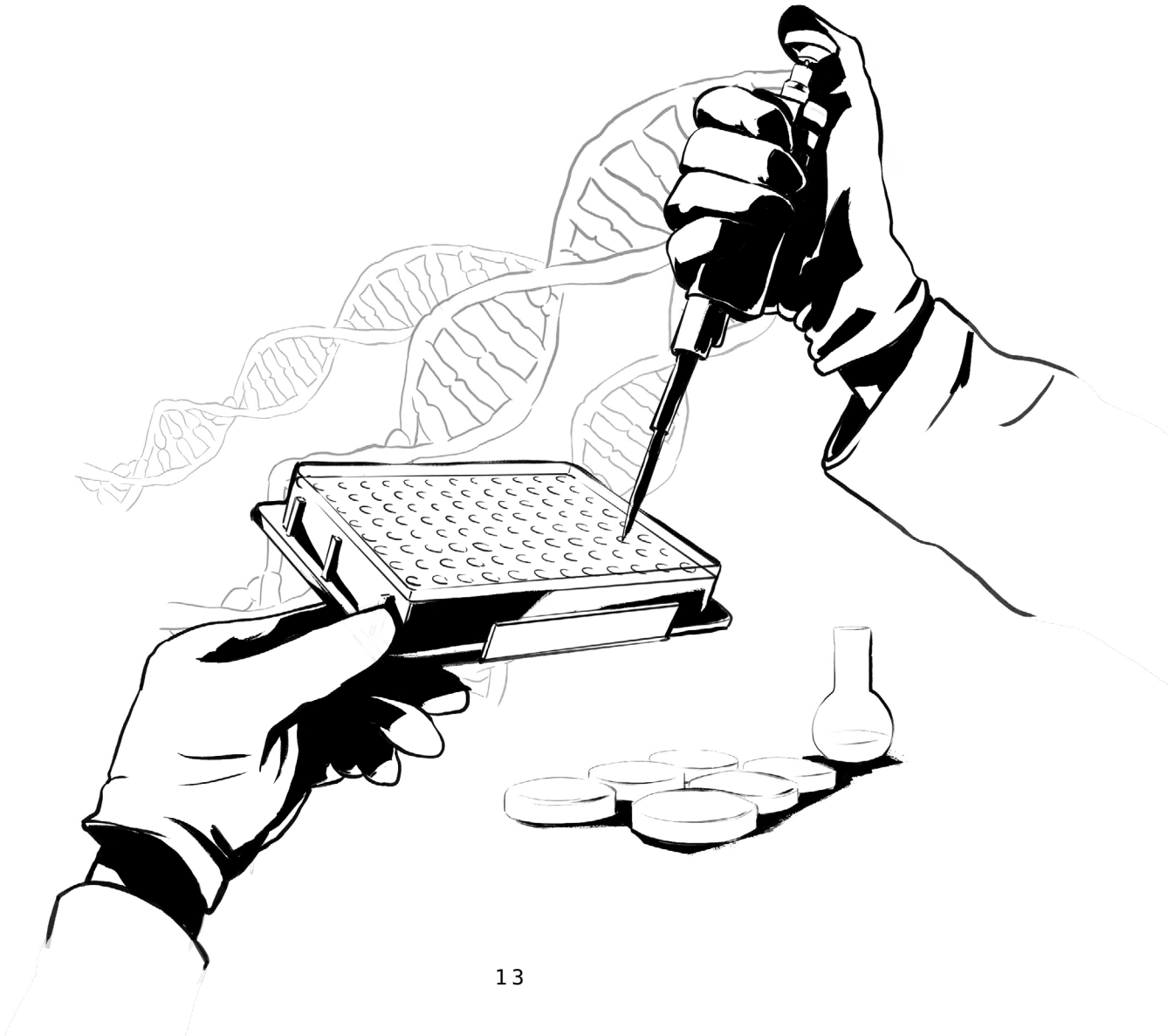
Environmental DNA (eDNA)

Ocean explorers can figure out what animals have been in parts of the ocean without even seeing them. How? By looking for information left behind in the water.

When people leave a room, they leave behind skin cells and hair, which have DNA (genetic material that carries all of the information about living things, including how things look and function) in them.
When sea creatures travel through an area, they leave behind skin, hair, scales, mucus, and even poop. That means that DNA is left in the water.

Environmental DNA is the DNA left behind as creatures pass through an area, and scientists can analyze this to figure out who has been visiting those waters. Scientists match the DNA that they find with existing libraries of DNA. Sometimes it turns out that the DNA found in the water does not match any known DNA patterns, and that means that those explorers may have found a new species!

The OceanXplorer has a DNA lab on board, though these labs can also be found in many universities and research centers. If a ship doesn't have its own DNA lab, the scientists can bring their water samples to labs when they return to land.

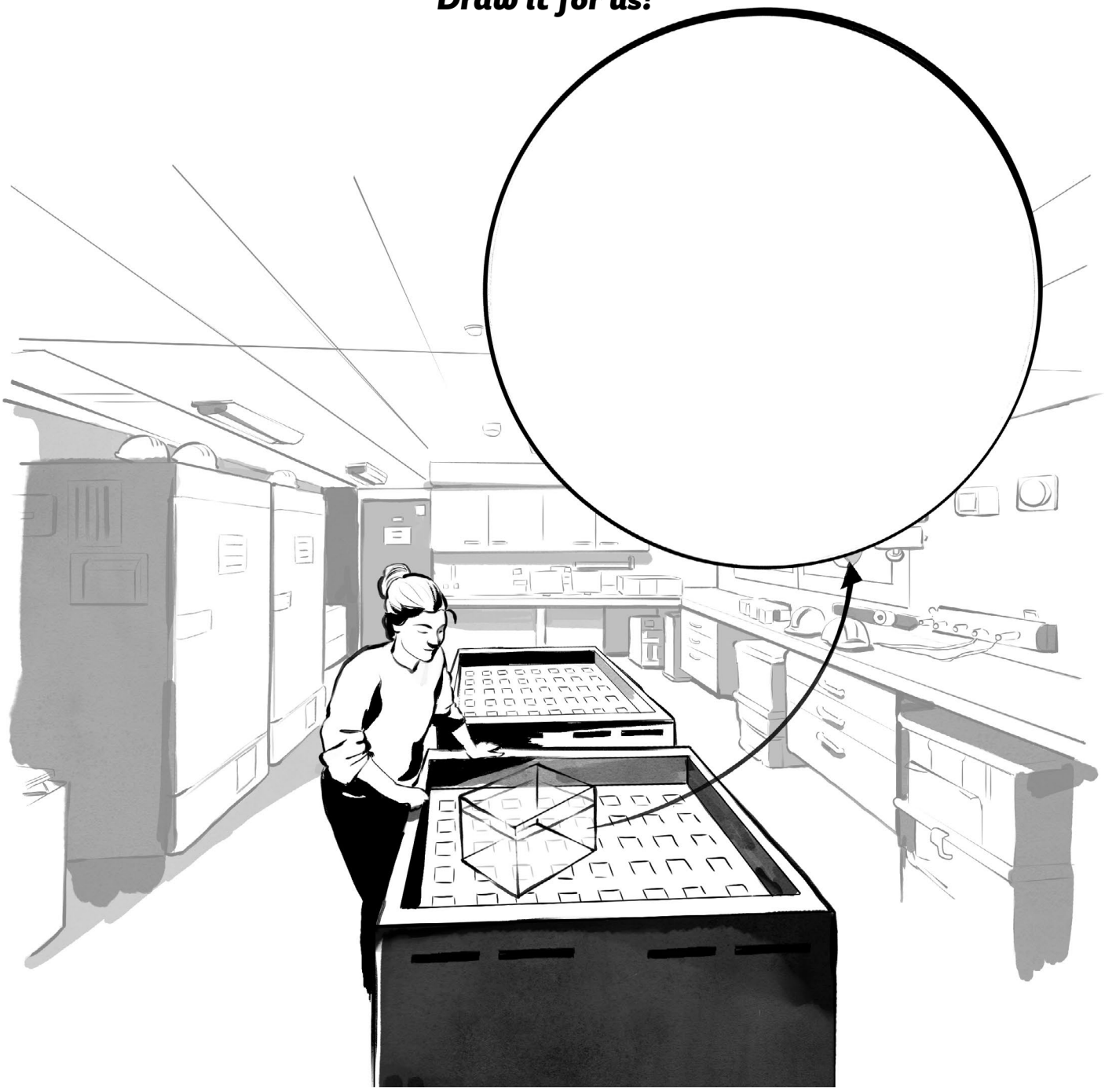


Wet Lab

Wet labs can be found on land and in research ships at sea. They are called wet labs because the room is designed to handle spills, chemicals, and lots of water. On a research vessel, the wet labs are where samples collected by the submersibles, ROV, and SCUBA divers would be brought.

OceanXplorer's wet laboratory is where sample testing, experiments, and analysis happens. In the wet lab, there are sinks, tanks, refrigerators, and freezers for samples, sampling, and analysis equipment.

What do you think is in the tank that this OceanX scientist is looking at? Draw it for us!

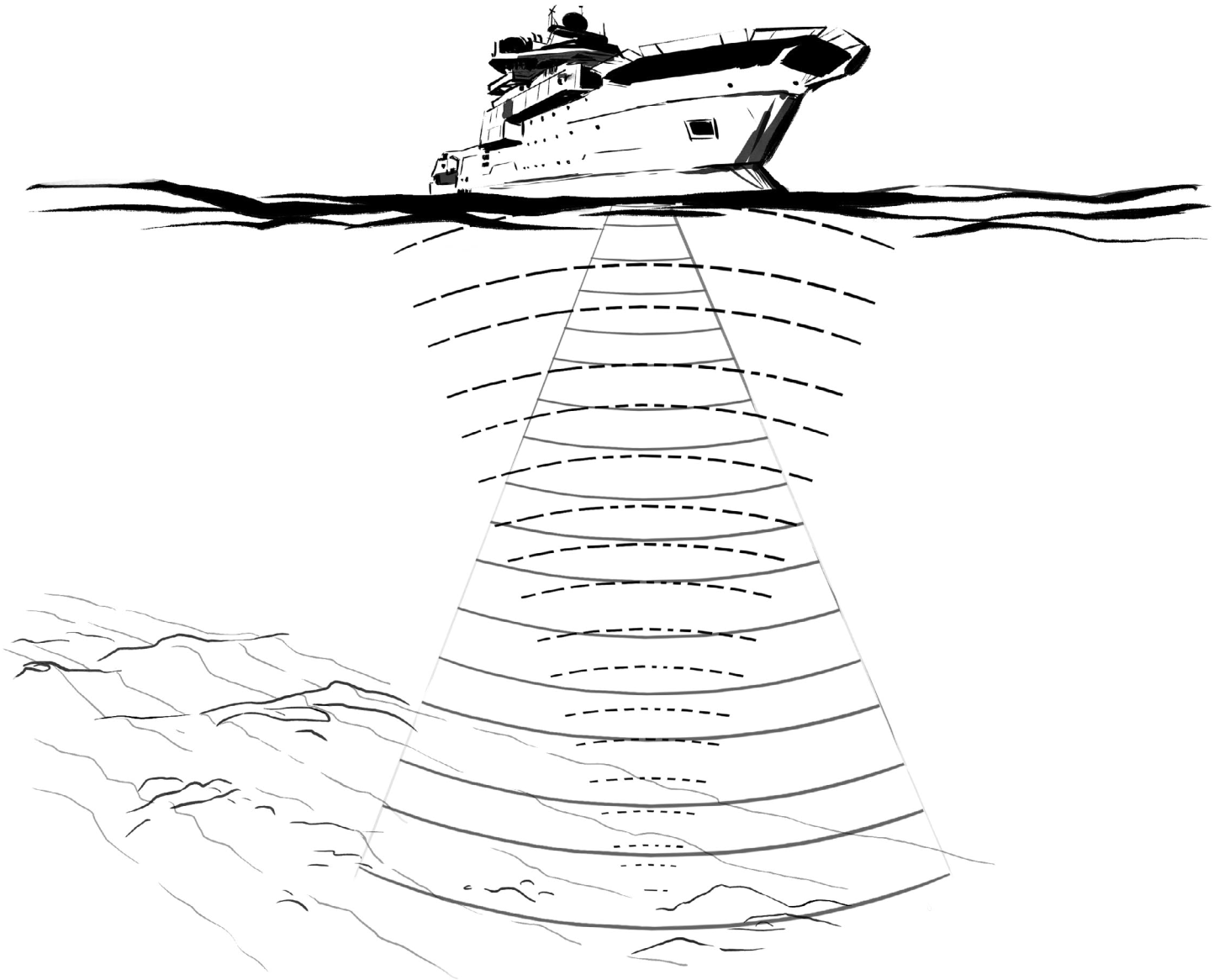


Acoustic Mapping

Seafloor maps show landforms below sea level to help us understand ocean habitats. Maps help us plan safe expeditions and teach us about the natural landforms in the ocean, since most of them are unexplored.

Most modern ocean floor maps are made using acoustic mapping. This means that sound waves are used to find out how deep the water is. Scientists send a signal from the bottom of a ship to bounce sound waves down to the bottom of the ocean and receive a return echo to determine how deep the seafloor below them is, depending on how long it takes for the sound to return. From these echoes, scientists can create maps of the seafloor.

Ocean creatures such as dolphins also use a similar method, called echolocation, where they create noises and then can navigate through the water based on the echoes of those sounds.



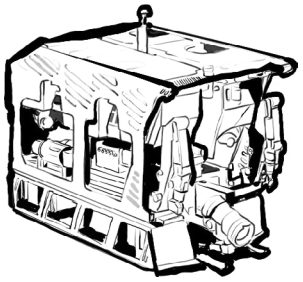
Ocean Exploration Careers

Ocean exploration is a team effort and involves many people who have a wide variety of skills and interests. Here are just a few of the careers involved in an expedition:

- **Captains** are responsible for all aspects of a research vessel and the safety of its crew. Ocean research expeditions involve many people, lots of equipment, and often dangerous weather and conditions. The captain is constantly assessing the situation and making choices to enable the success of the mission and the safety of everyone involved.

- **Ocean scientists** conduct experiments, collect data, and analyze trends to understand how our ocean works. Ocean exploration involves scientists from many specialties, such as marine biology, chemistry, and geology.

- **Submersible pilots** are responsible for the maintenance and operation of ocean submersibles. They make sure that the vehicle is ready to safely dive deep into the ocean, and then they are the ones driving the submersible and operating most of the equipment on board.



- **ROV pilots** maintain and control the remotely operated vehicles. Typically, the ROV pilot is on the ship that the ROV is attached to, and they are the one watching the video and sensor data coming from the robot in real time. They often work closely with the scientists and expedition leaders to ensure that the desired data and samples are collected.

- **Filmmakers** oversee all aspects of film production—from the idea, to writing, to the final movie or show. Ocean storytelling is an important way of getting people to care about protecting our ocean.

- **Chefs** on oceanographic research vessels are responsible for cooking and preparing the food that is served on the ship. Food is an important part of keeping an ocean expedition's crew happy, so the chef is a very important part of the team.

- **Acoustic Mapping specialists** use equipment including sonar to create maps of underwater environments and provide support on the ship for navigation.

- **Deckhands** maintain the ship and its mechanical equipment. They have to understand how the ship operates, the goal of each mission, and the environment.

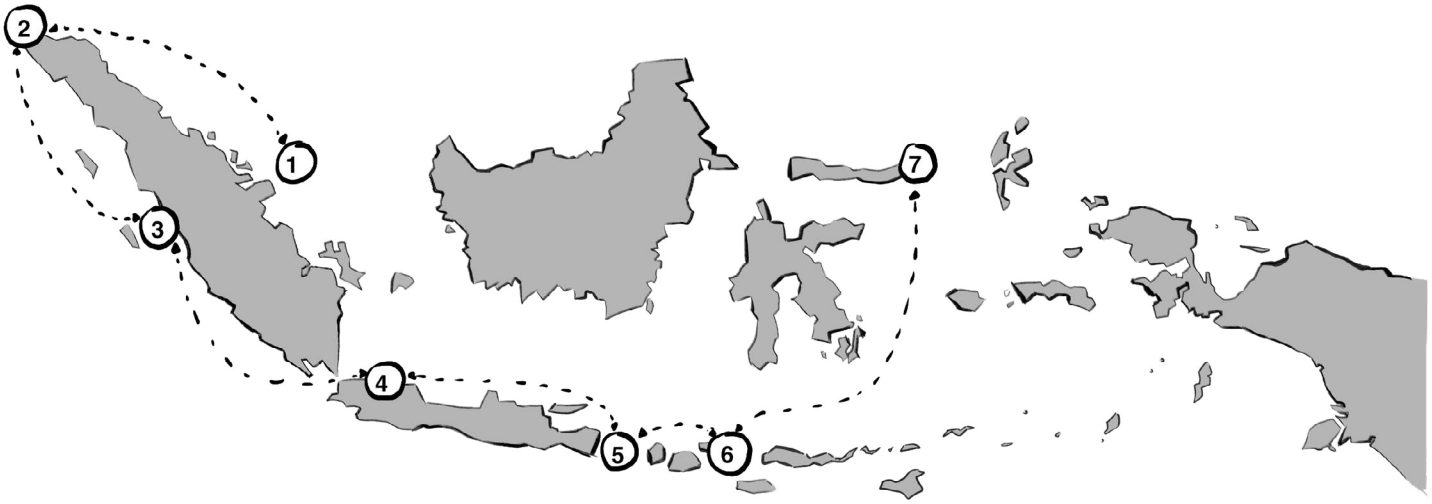
Which job do you find most interesting? Why?

OceanX Mission to Indonesia

In 2024, OceanX and its partners explored some of the waters surrounding Indonesia.

The mission team conducted scientific research, hosted educational programming, and developed media content that increased understanding and care for the ocean.

Research included a wide range of topics, including biodiversity, fisheries, geology, oceanography, big animals like whales and dolphins, and tsunami prediction.



Indonesia Expedition Route Plan

If you were designing an Indonesian oceanographic mission, what would you want to study?

Living Near the Ocean

Indonesia has a population of 270 million people. As a country made up of over 17,000 islands, most people live near the ocean. The ocean surrounding Indonesia is rich in biodiversity and home to coral reefs, mangroves, seagrass meadows, and deep-sea ecosystems. These habitats are special and important to life everywhere on Earth, so they must be protected. In the next six years, Indonesia wants to protect 32 million hectares of their ocean.

What is your relationship with the ocean? How does it make you feel? What are ways in which you depend on the ocean? It could be inspired by wildlife you have seen in the water or activities you have enjoyed in the sea. It could even be inspired by stories you have heard!

Write or draw your response.

Ocean Heroes in Indonesia

Coral Triangle Center

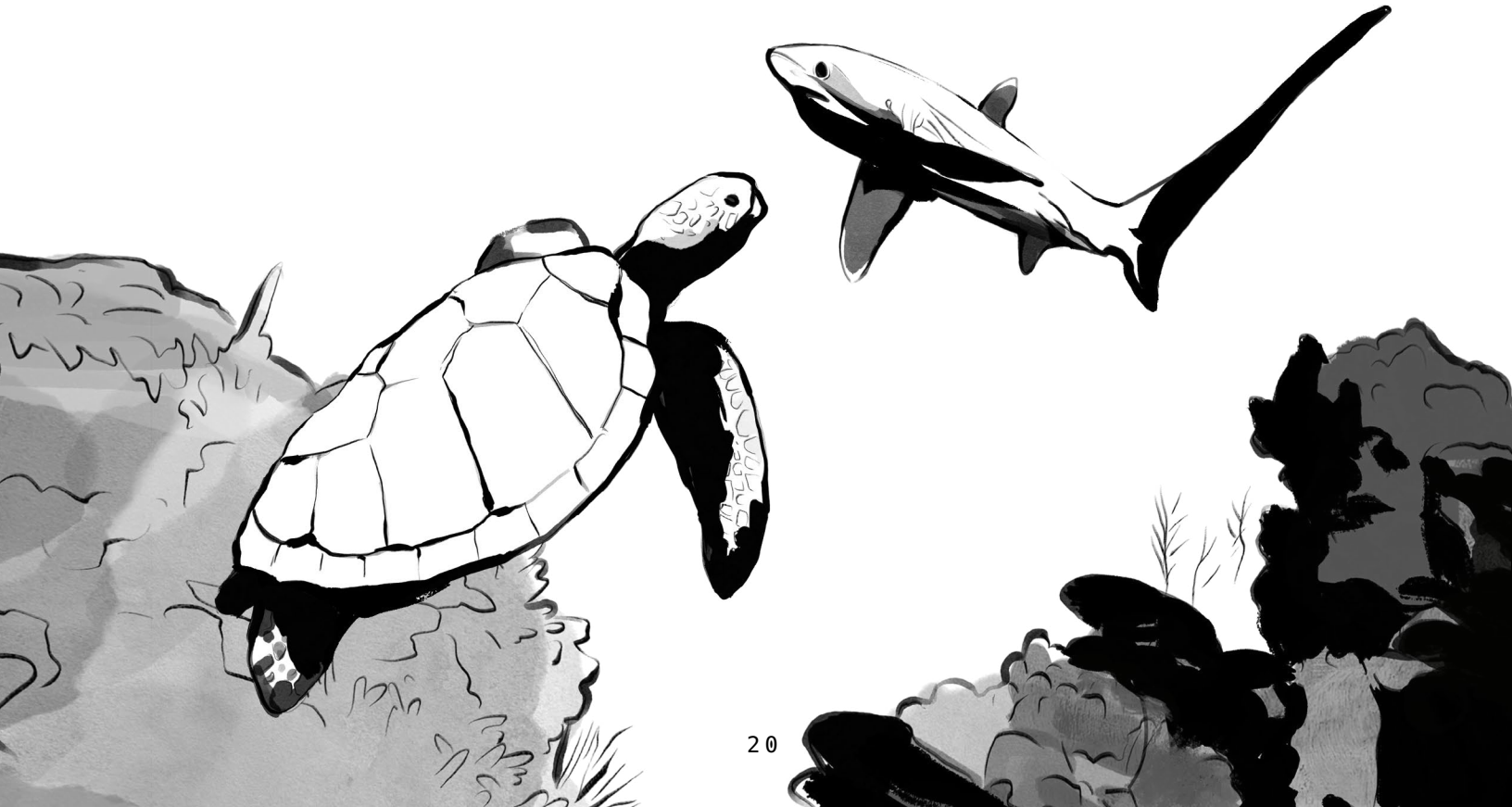
Coral Triangle Center is a foundation based in Indonesia that aims to promote the conservation of marine biodiversity and the sustainable management of marine and coastal resources across the Coral Triangle—the world's epicenter of marine biodiversity. They have protected 435,000 hectares of critical marine habitat, and have trained more than 7,600 people to support marine protected areas and sustainable fisheries management. They are developing a Center for Marine Conservation in Bali as an integrated learning space for training programs, outreach activities, interactive exhibits, and artistic and cultural performance.
Find out more at www.coraltrianglecenter.org

Thresher Shark Indonesia

Thresher Shark Indonesia started in 2018 by Indonesian young conservationists with the goal of protecting Indonesia's declining and endangered thresher shark population in the waters of Alor, East Nusa Tenggara. They provide policy recommendations and alternative livelihood solutions for shark-dependent communities in Indonesia. They work closely with local communities, governments, businesses, scientists, filmmakers, and other NGOs to develop long-term solutions that protect endangered shark species.
Find out more at https://threshershark.id

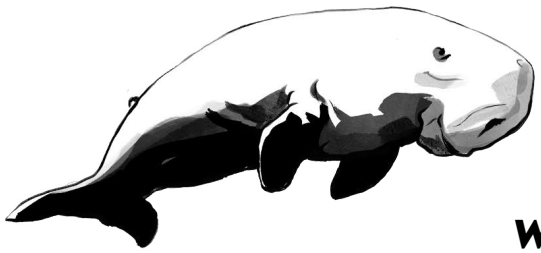
Bali Sea Turtle Society

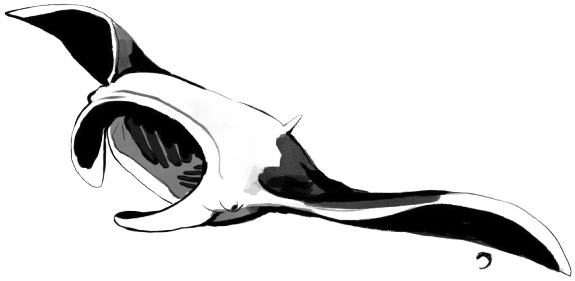
Bali Sea Turtle Society (BSTS) is a non-government organization founded in 2011 with the aim to protect the sea turtles and their habitat, and to raise public awareness regarding sea turtle protection. BSTS works to involve and train local communities to protect sea turtles through Community Based Conservation programs such as sea turtle nest protection, education, and information campaigns. Find out more at https://baliseaturtle.org



Tamang Dugong
Tamang Dugong is a youth-led non-government organization founded in May 2020 with a mission to protect and preserve the endangered dugong species in Indonesia with a focus on digital creative campaigns. The organization is also focused on raising awareness of the protection of dwindling seagrass and dugong populations in Eastern Indonesia.
Find out more at https://tamangdugong.id

Elasmobranch Project Indonesia
Elasmobranch Project Indonesia (EPI) is a South Tangerang–based non-profit organization working to support shark and ray conservation in Indonesia through citizen science, research, and awareness campaigns both in person and virtually. EPI aims to map the biodiversity and distribution of shark and ray species in Indonesia with the help of citizen scientists. EPI is conducting two species-specific projects on rhino rays (giant guitarfish and wedgefish) in Karimunjawa National Park and on the Raja Ampat epaulette shark in the Raja Ampat archipelago.
Find out more at https://elasmobranch.id





Who is your ocean hero?
How are they working to protect the ocean?

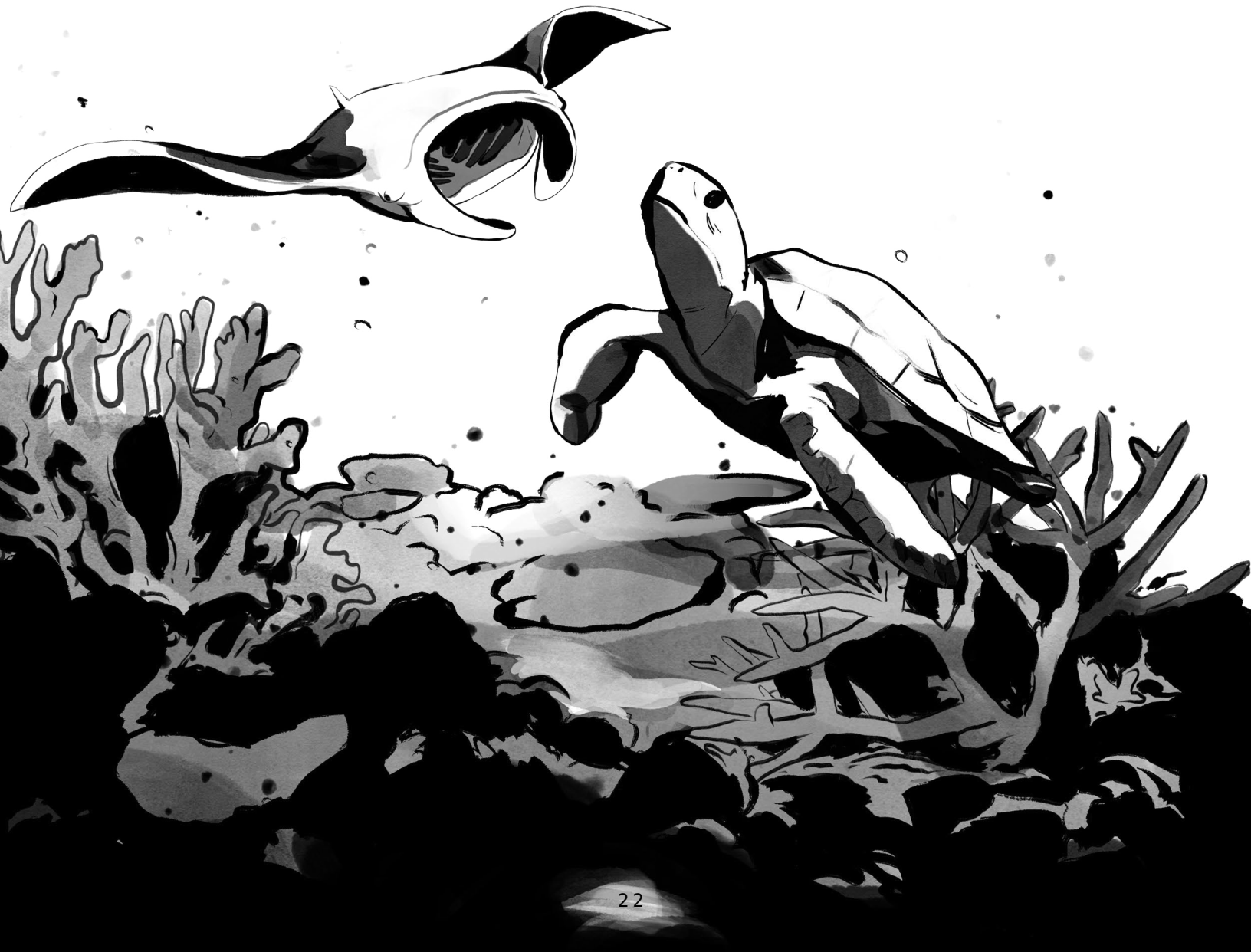
Coral Reefs in Indonesia

Coral reefs are the most biologically diverse marine ecosystems on Earth. Mostly found in shallow depths of water, this ecosystem is made up of colonies of hard and soft corals.

Coral reefs are important because they:

- Provide shelter, food, or breeding grounds for 25% of all marine species
- Protect shores from high-impact waves
- Provide income and food for millions of people living along the coasts

Indonesia has some of the largest and most biodiverse coral reefs in the world. Indonesia is part of the Coral Triangle and is home to almost 75% of the world's coral species and almost 40% of the world's fish species. The Coral Triangle is known for its marine biodiversity, not only of corals and fish, but also of many other marine organisms.
Apart from Indonesian waters, the Coral Triangle also includes waters from Malaysia, the Philippines, Papua New Guinea, Timor-Leste, and the Solomon Islands too.



Mangroves in Indonesia

Mangroves are groups of trees that live along the coastlines of Indonesia. There are many varieties of mangroves, including some that are easily recognizable because of their thick tangles of roots that make the trees look like they are standing on stilts in the water. Mangrove ecosystems provide coastal protection from storms, floods, and erosion; provide habitats and nurseries for many fish, invertebrates, and birds; provide natural resources and materials for many people (especially coastal communities); and absorb large amounts of carbon dioxide.

Indonesian mangroves are the most diverse in the world, consisting of 92 different species that cover approximately 3.4 million hectares of land, the largest area of mangrove coverage in the world.
However, mangroves are disappearing at alarming rates as they are being cut down for agriculture, aquaculture, and urban development. Without mangroves, Indonesia will be at risk of losing an important source of livelihood and being exposed to coastal erosion, storm damage, and rising sea levels.

Seagrasses in Indonesia

Seagrasses are underwater plants that live in shallow, calm, coastal, salty waters and have roots, stems, leaves, and flowers. Unlike their name suggests and unlike their seaweed-like appearance, they are flowering plants closely related to lilies and ginger—the only flowering plants that can survive in seawater.

Seagrass meadows serve as important feeding grounds, nurseries, and homes for many marine species such as fish, seahorses, turtles, and dugong. Adult green turtles eat about 2 kg of seagrass per day! Seagrass also stabilizes the seabed during storms, filters the water, and releases lots of oxygen.

The area of known seagrass beds in Indonesia is recorded at around 293,464 hectares, though it is estimated that the actual area of Indonesian seagrass beds may be over 1 million hectares. Ocean exploration is likely to find many more seagrass beds!

The Deep Seas in Indonesia

Deep-sea ecosystems are found in parts of the sea with depths exceeding 500 meters. The deepest parts of the world's oceans are cold and dark because sunlight does not reach those depths, with crushing pressures from the weight of the water above. Animals that live in these deep-sea ecosystems have a variety of interesting adaptations, such as fish that make their own light, like anglerfish!

About 60% of Indonesia's seas are more than 200 meters deep. The deepest point in Indonesia is located in the Banda Sea. Its deep-sea ecosystems are important migratory routes for tuna, blue whales, and hammerhead sharks.

Plastic Pollution

Plastic waste makes up 80% of all ocean pollution.

Humans use plastic for many things, including toys, toothbrushes, bottles, bags, mobile phones, and more. Plastic takes hundreds of years to break down. This means that your plastic toothbrush will likely exist for hundreds of years, well beyond the amount of time it is useful.

When plastic does degrade, it turns into smaller pieces called microplastics. Microplastics pollute the marine environment and can be eaten by marine animals.

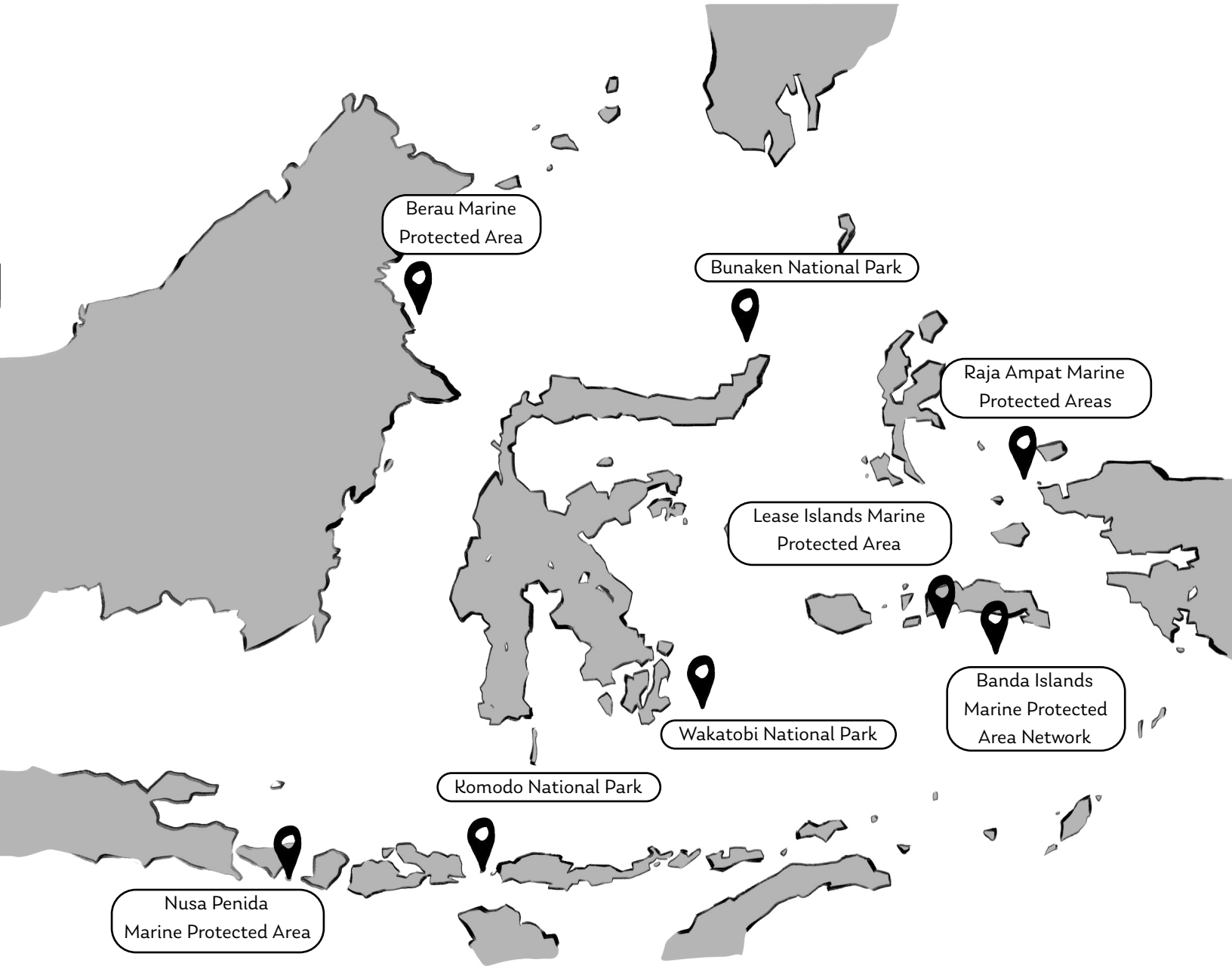
People are working hard to remove plastic from beaches and the ocean, but we also need creative ways to reduce the use of these materials.

How can you help to reduce the amount of plastic in the ocean?

Marine Protected Areas

Marine Protected Areas (MPAs) are regions that are managed for long-term conservation of marine resources and cultural heritage. The regulations in marine protected areas vary based on their purpose. Some do not allow any fishing, while others allow for multiple uses such as traditional fishing, recreation, and research.

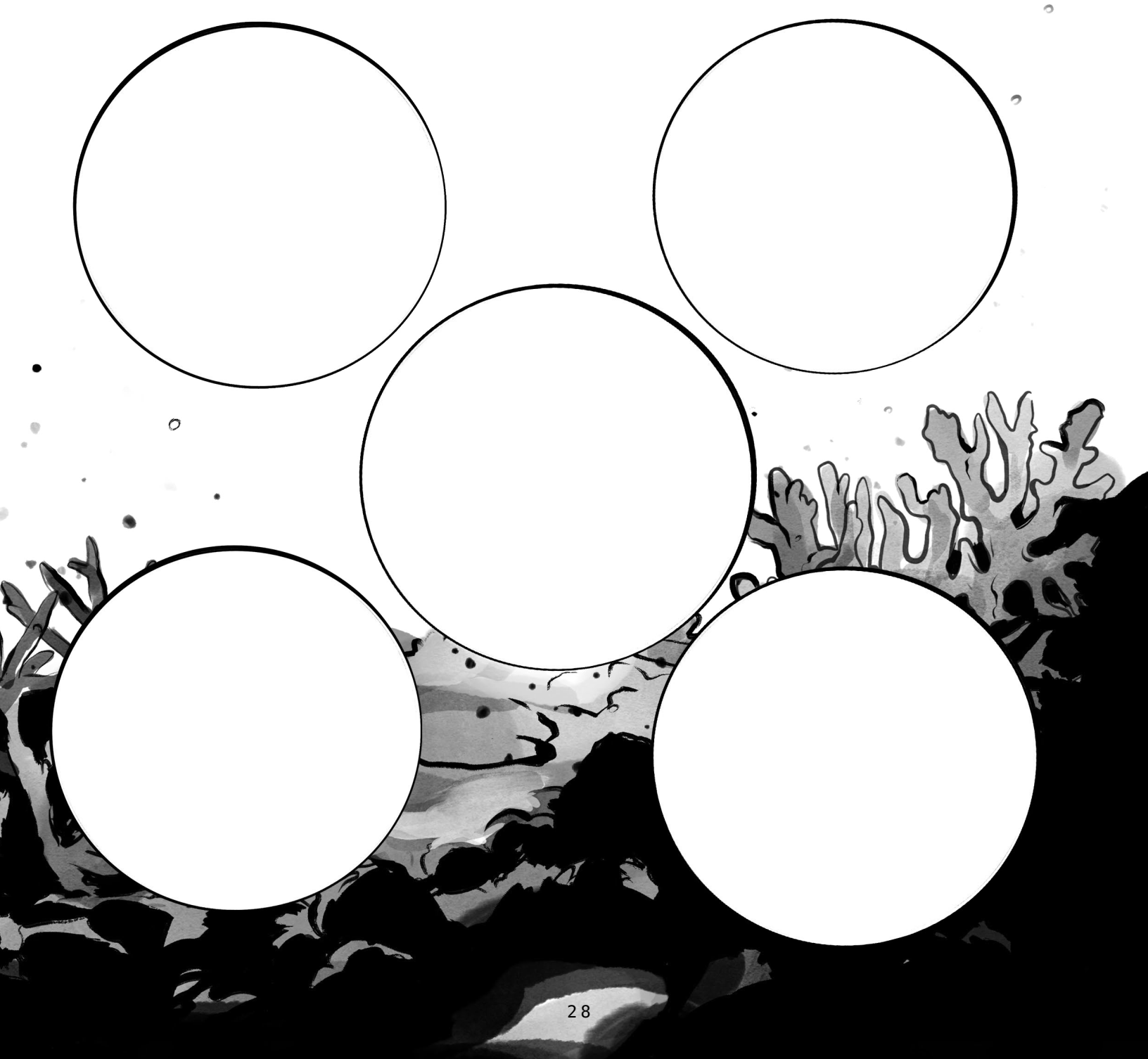
In Indonesia, there are over 400 marine protected areas. These MPAs are managed by government agencies and local communities to conserve marine life and coastal resources. However, there is still much work to be done to protect and conserve our resources. This map below shows just a few of these MPAs.



How can we help the ocean and the creatures that live there?

Even someone who lives far away from the ocean is impacted by it. Every one of us can have an impact and help protect our ocean.

Write down, or draw, 5 ideas you have for actions that will make a positive impact on the ocean.



OCEANX Education

Hello educators!
This book is a prototype of an OceanX Education's classroom resource for primary school students. We would love to hear your feedback. Please send your ideas and suggestions to education@oceanx.org, and also let us know if you would like copies for your students.

OceanX is an ocean exploration initiative that combines science, technology, and media to explore and raise awareness for the oceans and create a community engaged with protecting them. OceanX supports and facilitates ocean research for scientists, science institutions, media companies, and philanthropy partners.

OceanX Education is creating a generation of passionate ocean leaders who will use their knowledge of the ocean to have a profound and positive impact on our planet. The nonprofit initiative educates young people about the importance of ocean conservation, research, and science communication to bring more diverse voices into the critical conversations about the biggest issues facing our planet. OceanX Education is bringing programming and opportunities for deep-sea exploration, media, and innovation to audiences around the world, serving the education community with a rare behind-the-scenes chance to understand deep- sea exploration and media production.

CORAL TRIANGLE CENTER
Inspiring People Saving Oceans

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