le Mag tara océan

n° 4

FOR CHILDREN BETWEEN 8 AND 14 YEARS OLD!

EXPLORE
UNDERSTAND
PROTECT

SEVEN DUOS TOGETHER FOR LIFE!

Create YOUR OWN MINI-MAG

WE ARE ALL CONNECTED TO THE OCEAN!

Illustrations: Anaïs Chevret.

Fondation tara océan explore and share

In the same **boat**

WORKING TOGETHER TO UNDERSTAND BETTER

For over twenty years the Tara Ocean Foundation has been exploring the world's seas to better understand them and protect them. During its expeditions, the Foundation works with international scientists who specialize in very different disciplines, such as oceanography, biology, chemistry and computer science. They are all connected so that they can work hand in hand, at sea or on land, to understand the world we live in.

1 BEFORE THE EXPEDITION

Using very precise criteria, researchers choose the places they wish to study. If they want to take water samples, they need to secure the permission of the authorities of the countries concerned. They organize every detail of the expedition schedule and fit the ship out with scientific equipment. And once the preliminary work is done, they are ready to collect small amounts of water, air, soil and even worms and seaweed to study. They call these "samples" or "specimens".

2 ONE SINGLE SPECIMEN PROVIDES LITTLE DATA, ONE SINGLE SCIENTIST CANNOT UNDERSTAND EVERYTHING: LEARNING REQUIRES US TO WORK TOGETHER!

Scientists put together pieces of a puzzle in order to understand crucial questions. How do the oceans affect the climate? What role does biodiversity play in the living world? What are the greatest causes of pollution? Little by little as we attempt to answer these questions, we find solutions that we can implement to protect the health of the oceans and the planet, our home!

THE SURGEONFISH AND THE TURTLE

Together for life

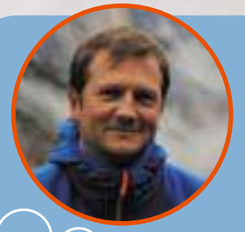
The shell of the turtle is covered with tiny algae and small crustaceans known as "barnacles". Surgeonfish think they are delicious. They come to feed on the turtle's shell. It's a profitable association for both of them. For the turtle, a clean shell lessens the risk of contracting diseases. For the surgeonfish, it's a great source of food.

3 DURING THE EXPEDITION

Aboard the Tara, scientists use satellite data to pinpoint the areas where they want to collect specimens. When the time comes, the crew positions the schooner in the right place and the scientist start **"sampling"**.

For example, in the case of collecting plankton specimens, seawater is brought on board and filtered to concentrate the plankton it contains. The sample is then placed in a small 5 ml tube labelled with a unique barcode. These barcodes, which are the same as the ones you see on products in shops, ensure the traceability of the sample! The tube is then steeped in liquid nitrogen which instantly freezes the contents and ensures that it remains in perfect condition until it can be studied. Minus 196 °C is very, very cold!

When the ship is next in port, the sample is transferred to a cool box for transportation to the laboratory. The cool box is filled with dry ice, a solid form of carbon dioxide which keeps the samples at -78.5 °C.



DAMIEN ÉVEILLARD

is an oceanographer and biologist at the LINA IT laboratory at Nantes University. He assembles all the digital data obtained by Julie for each sample collected by the Tara.

Our job is to get all these millions of pieces of data to tell us about the living world, from the smallest organisms to the largest. DNA allows us to understand the chemical reactions that occur at the microscopic level of the molecule. We use information technology and powerful computational tools to analyse the interactions between species. This enables us to better comprehend the Earth's vast climate system. "

JULIE POULAIN

is a research engineer and she interprets the results.

Each sample received from the Tara gives me the impression that I'm pushing back the boundaries of the invisible world in just 5 ml of seawater. Genetics are essential for identifying and classifying the infinitely small. Making sense of the genetic sequences – the pieces of the puzzle – is what we do in my profession. In practical terms, a sample can be sequenced several times in relation to various scientific questions, and it can be used by other laboratories. We all need each other, too. "

4 AFTER THE EXPEDITION

On arrival in a partner laboratory, the sample is placed in an immense database along with all its relevant information. This means that we will always know where it came from, what it contains, and where it's stored – in which freezer, in which drawer and in which box! We can retrieve it at any moment, even in ten or fifty years' time. And then we undertake a series of analyses to decode the secrets of its DNA. In short, we study the sample meticulously to identify the units we need to piece together its genetic identity* which we call DNA**. The "sequences" of the sample are then analysed by algorithms (in other words, mathematical computer programs) to complete the puzzle of its DNA using all the information that has been discovered.

* Genetics is the scientific study of how certain characteristics, such as eye colour, are transmitted from parent to child. This can be studied in every single animal and plant species!

** DNA is a succession of instructions. These instructions are written a bit like our alphabet, but with only four letters. It is these "sequences" or chains of letters that scientists try to read.

Photo credits: CEA Gilles Martin, Maéva Bardy © Tara Ocean Foundation, EMBL / EBI. Illustrations: Anaïs Chevret.

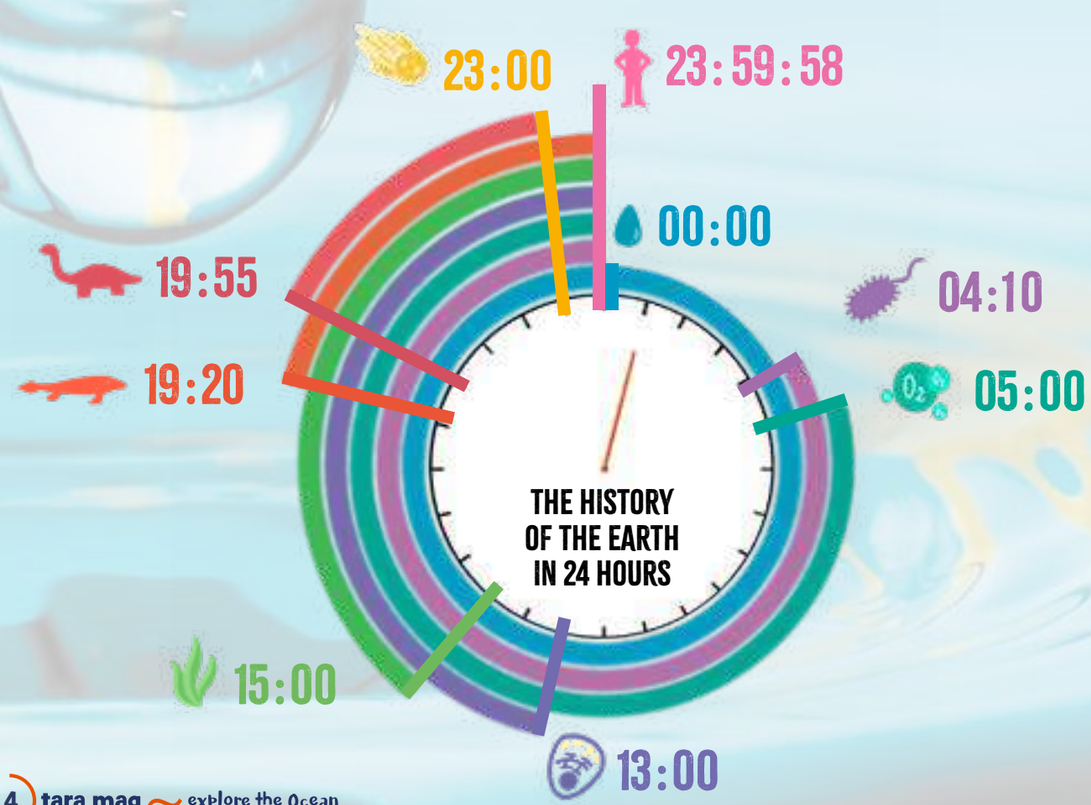
Ticktock,
life on earth!

THE BOXER CRAB AND THE ANEMONE
Together for life

In the Indian Ocean lives a very playful crab whose best friend is the sea anemone! Lybia Tessellata is a pretty red and white crab which is also called the "boxer crab". When it goes for a walk it carries an anemone in each of its claws. If it comes up against a predator it will shake the anemones as a warning. If that doesn't work, it will start boxing and throw the anemones at the potential predator's head. The anemones sting like nettles... So it's better to keep your distance! As for the anemones, they get to eat the crab's leftovers. It's a win-win situation for the team!

LIFE STARTS IN THE OCEANS

In the history of our planet, we humans appeared very recently. If the Earth were twenty-four hours old, then humans would have appeared a couple of seconds before the end of the day. And yet, we have had and continue to have an enormous impact on the world.
Our Earth has lived through many periods which we call "geologic eras". Since the Industrial Revolution we have been living in the "Anthropocene", a period in which human activities have been dominant. But there is still time to make a difference and set things right. We must take care of our planet because our survival depends on it.



4.5 billion years ago

00:00 One Earth, one Ocean

The Earth was formed about 4.6 billion years ago, and this is the start of our "geological day". The formation of the Moon cools the surface of our planet. The Earth changes from being an ocean of hot magma to a planet covered in water. The oceans were born approximately 4.5 billion years ago!

04:10 Life appears!

The first lifeforms appear… in the sea! These early creatures are simple cells or bacteria living in the oceans.

05:00 Oxygen

Certain types of bacteria called cyanobacteria begin to produce and release oxygen. These bacteria use the sun's energy to produce oxygen. This oxygen forms the ozone layer which continues to protect us from the sun's ultraviolet rays today.

13:00 Complex cells

Over time cells begin to evolve. They now have compartments and a nucleus!

15:00 Cells aggregate

Life becomes a little more complex… The first organisms made up of several cells appear. Among these pioneers are algae or seaweed! Today, many of the organisms you are familiar with are multicellular, such as mushrooms, plants, animals… and even you!

19:20 Out of the ocean and onto land

Life as we know it develops first in the oceans. Molluscs, shellfish and the first vertebrates appear. And then life evolves on the land, first plants and later animals. Not long after that the Earth experiences a mass extinction event where 70% of land animals and more than 90% of marine species disappear.

19:55 Reign of the dinosaurs

It's the start of the reign of the dinosaurs, which have taken the place of the organisms that died out during the mass extinction.

23:00 Demise of the dinosaurs

Dinosaurs enjoy a long life on Earth until an enormous meteorite falls into the Gulf of Mexico, causing the extinction of 75% of the species living at that time.

23:59:58 Humans appear
On the scale of our history of the Earth in twenty-fours, we humans appear in the final two seconds!

Evolution leads to the appearance of the hominid family (great apes) at 23:59:54. Human evolution passes through several stages and at 23:59:58 the first Homo sapiens appear.

2.5 million years ago

Photo credits: Shutterstock.
Illustrations: Anaïs Chevret.

The Ocean seen **from land**

THE OCEAN, AN UNKNOWN WORLD

Our Planet Is Home to Incredible Landscapes!
There are many extraordinary places between the oceans and the continents. And contrary to what you might think, the land and the oceans really aren't so different. Let's take a look at our planet from another angle!

Higher than the level of the Ocean!

You can find traces of marine fossils all over the world, and even in the mountains. Yes, in the mountains! For example about 150,000 years ago the famous Alps were under water!

The world's highest mountain is... an underwater volcano!

In Hawaii there is a volcano called Mauna Kea which is about 10,000 m high! It is much taller than Mount Everest, which measures 8,849 m. Although its peak is only 4,000 m above sea level, the volcano is in fact 5,800 m higher if we take into consideration its vast underwater base in the Pacific Ocean!

The Ocean, a silent but noisy world!

Despite what most people think, sound does travel underwater! Many species of fish and whale use sound to communicate and find their way around. Unfortunately, noises produced by ships create a real din below the waves. For example, dolphins are very sensitive to noise pollution because it disrupts how they mate, educate their young and find food.

The world's largest meadow is... in the Ocean!

In 2021 the largest meadow in the world was discovered at the bottom of the Indian Ocean. Its surface area is the size of Switzerland, about 42,000 km². This meadow, known as the Saya de Malha Bank, is a vast seagrass bed. It is home to an incredible biodiversity and like many of the world's plants, it plays an essential role in reducing the effects of climate change.

THE ROSCOFF WORM AND TETRASELMIS ALGAE
Together for life

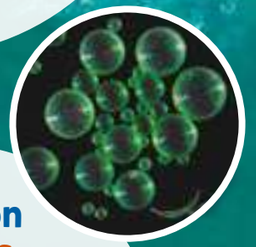
If you have ever been to the beach in Brittany, you may well have noticed some unusual green streaks on the sand. If you take a closer look, you will see that they are made up of millions of little flatworms which are about 4 mm long. They are called "Roscoff worms". Their lovely green colour comes from the presence of Tetraselmis convolutae, a microalga which the worm hosts under its epidermis. If the worm and the alga fail to meet each other, the worm will die. Once it enters the worm, the alga loses its external layer and the organs that allow it to move, its flagella. It then multiplies and photosynthesizes, which provides the worm with lots of nutrients. A harmonious and very fruitful relationship.

The atlantic puffin, a deep-sea bird that breeds on the coast

The Atlantic or common puffin is a small seabird of the auk family.
It is especially well-known for its colourful beak. It is equally comfortable flying in the air as it is fishing underwater! It normally lives far from land but it has to return to the coast to breed, lay its eggs and bring up its young!

Below the waves, life lights up the deep!

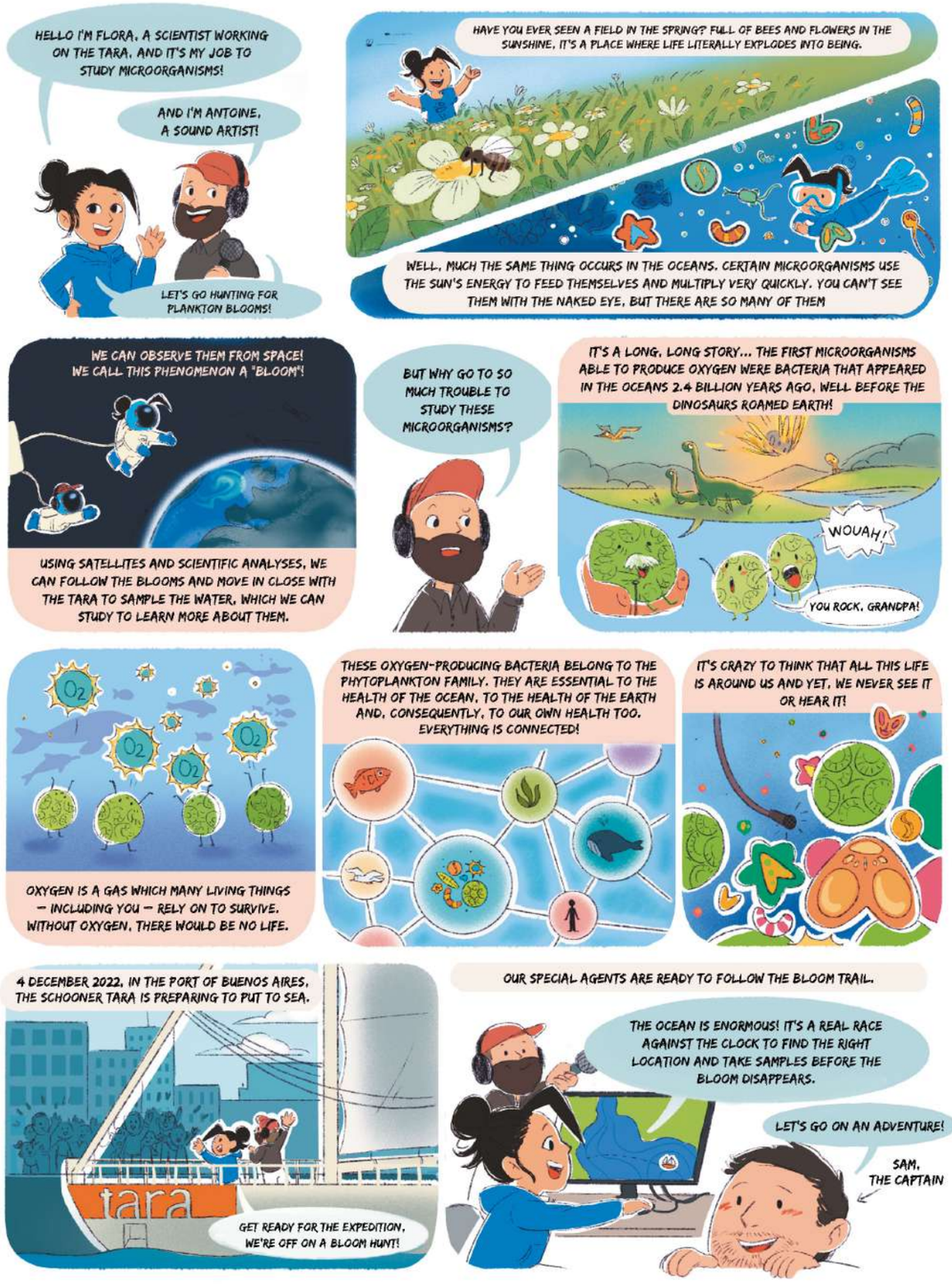
In the depths of the oceans where the sun's rays can never reach, life continues in the darkness. But living creatures are full of surprises! Certain species are able to illuminate the deep thanks to a chemical reaction which produces light. For example, the anglerfish can shine in depths of 4,000 below sea level. It uses its magnificent lantern to attract its prey!



Plankton seasons

Seasons don't just affect life on land! Below the sea's surface, sunshine, temperature and wind all have a significant impact on phytoplankton. In the spring these bacteria and microalgae use the sun to develop and reproduce, like land plants produce buds. A veritable explosion of life.

Bloom hunting aboard the *Tara*



Story based on the experiences of artist Antoine Bertin and scientist Flora Vincent aboard the Tara during the Mission Microbiomes expedition.
Illustrations: Anaïs Chevret.

Once upon **a time**

As surprising as it might seem, manta rays in the North Pacific rely on the trees of the Palmyra Atoll for food. How can this be? Trees native to the atoll grow right up to the water's edge, providing an ideal habitat for seabirds. The birds nest in the trees and... their droppings fall into the water! Bird droppings make great fertilizer for the small algae (phytoplankton) living in the water, and these multiply considerably. But who eats these tiny plants? Microorganisms feed on the algae, such as small shrimps and fish larvae (zooplankton) which in turn are consumed by the manta rays. It just goes to show, nothing goes to waste!

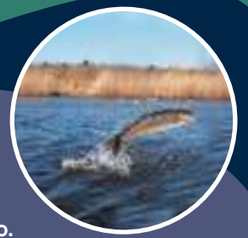
WATER, LINKING LIFE ON LAND AND AT SEA

The Ocean connects all the continents! There are no boundaries between land and sea. At the heart of everything is WATER, the essential element for life on Earth. Throughout the Earth's existence, its surface has been constantly changing. Some 250 million years ago the continents were not separated like they are today. Back then the Ocean surrounded one single continent which we call Pangaea. Today, the mass of water is the same as it was then, it's just that the continents have moved away from each other. Nevertheless, the Ocean remains the link between them.

Water is life

Water is everywhere, even at the heart of the land masses. The rivers act as arteries which supply the continents and the oceans with the substances or "nutrients" needed to support life. As water moves around the world, it is mixed and modified. For example, when freshwater from the rivers and saltwater from the oceans meets in estuaries, the water becomes full of life and biodiversity because many species, such as fish and crustaceans, come to feed there.

In water, life knows no boundaries

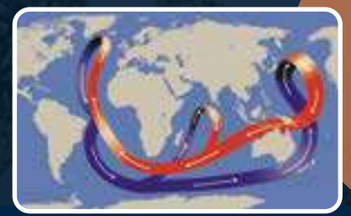


Many species connect the world's oceans, continents and rivers too.
For example, migratory fish such as salmon are born in rivers. They then swim downstream to the sea where they feed on shrimps and other small fish. Once they have become strong enough, they swim back up the river to breed and live out their final days. After laying her eggs, the female salmon is exhausted and generally dies soon thereafter. Dead salmon sink to the bottom of the river where they decompose and release the nutrients they had previously acquired in the sea. It's an important source of nourishment for river and forest ecosystems! Isn't it astonishing how everything is interdependent?

The water cycle, from land to sea and back

Over time, a single water droplet goes through many changes. It can be salty, fresh, underground, vapour and ice. Under the effect of the sun's heat, water evaporates and rises into the sky where it condenses into clouds. It can then travel great distances before falling back down to Earth as rain!

A single water droplet takes 1,000 years to travel through the Ocean.



Currents, the world's thermostat.

Sea currents are constantly stirring the entire layer of water that covers Earth, moving millions of litres of water around the world.
This movement never stops, heats our "blue planet" and allows us to live in a temperate climate.

Microdroplets of water blowing in the wind

Some water droplets are so small that they float in the air! They are part of what we call "aerosols", that is to say tiny particles that cannot be seen with the naked eye. Aerosols can be liquids, in the form of droplets, or solids in the form of dust. Dust from the Sahara has been found in the Amazon. Scientists have even managed to work out that the dust travelled 4,000 km in just ten days! Aerosols have an enormous impact on the climate and our health. They can carry viruses from the other side of the world and influence the formation of clouds. It's a fascinating new subject for scientists to study. You are going to hear a lot more about aerosols in the future!

Working together for change

The great natural systems shown on this page are essential to life on Earth. Protecting them was one of the reasons why the 193 member states of the United Nations (UN) agreed on seventeen goals to be achieved by 2030: the Sustainable Development Goals or SDGs.

As you can see from the little icons, some are designed to protect the oceans and the environment through the combined action of the states. The SDGs highlight how we are all interconnected.

You can contribute to achieving these goals too! Everything we do every day affects the entire planet in some way, on land and in the sea.

We are all connected to each other for a shared and sustainable future!

Photo credits: © Maxime Horlaville, Maéva Bardy / © Tara Ocean Foundation, © Shutterstock. Illustrations: Anaïs Chevret.

An extraordinary **expedition**

The schooner Tara is setting out on a unique expedition! For eighteen months the scientific sailing vessel and roving laboratories on wheels will be studying the environment on land and at sea along the coasts of Europe. Their goal will be to study the impacts humans have on biodiversity on land and at sea.

A SCIENTIFIC EXPEDITION ON LAND AND SEA

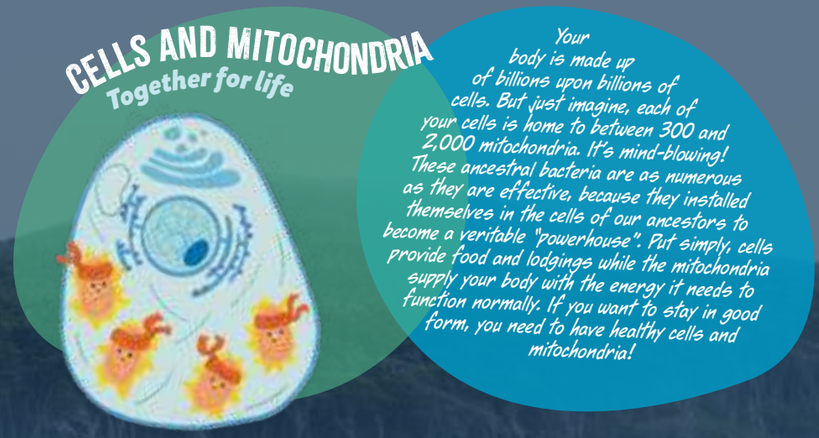
TWO EXPEDITIONS IN ONE!

TREC

Tara Europa, the new expedition of the schooner Tara, will be at the heart of a major European scientific expedition called TREC, which stands for Traversing European Coastlines. It is organized by the European Molecular Biology Laboratory (EMBL) which is currently launching a research programme: Molecules to Ecosystems.

A flagship expedition!

Putting together a scientific expedition which takes place on land and at sea requires a lot of organizing! The schooner Tara will be required to approach the coast, sometimes as close as 100 m, and deal with complex sailing conditions relating to the tides, shallow waters and various other obstacles, including maritime traffic. Simultaneously, shore-based teams will have to manage access to a series of places and environments, sometimes in very unpredictable weather conditions. Every day will be a challenge!



WE ARE ALL CONNECTED

Diverse environments along the coast

We are part of a vast network we call the "natural world" which connects us to each other. Even when we are far inland we still impact the oceans through, for example, pollution by chemical products and plastics, but also because of the way we manage our energy sources, which causes global warming. The continents and the seas are home to a considerable number of invisible species that play a very important role in human health. Best we learn how to protect them!

Life of every size

For the first time ever, researchers from all over Europe will be converging on the TREC expedition to study life in all its forms, from the tiniest virus to the largest ecosystem. The goal is to understand precisely how biodiversity on land and at sea is going to evolve in reaction to changes in the environment. Scientists hope to find the answers as they explore the coast of Europe from Finland to Crete!

A time machine

Certain specimens allow us to look back in time! By taking core samples from marine sediment lying at great depths, scientists are able to identify species and climatic conditions which occurred in the past. With just a metre-long sediment sample, researchers can go 200 years back in time to the early days of the Industrial Revolution!

Photo credits: Marin Le Roux - PolaRYSE © Tara Ocean Foundation
Illustrations: Anaïs Chevret.
Graphics: Studio v2

ROVING LABORATORIES

a floating laboratory

AT SEA

12 seamen in rotation

40 scientists aboard

17 port visits

roving laboratories

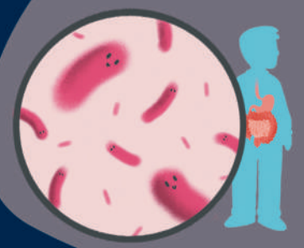
ON LAND

14 scientists aboard

29 countries traversed

We are all **connected**

HUMAN BEINGS AND MICROBES
Together for life



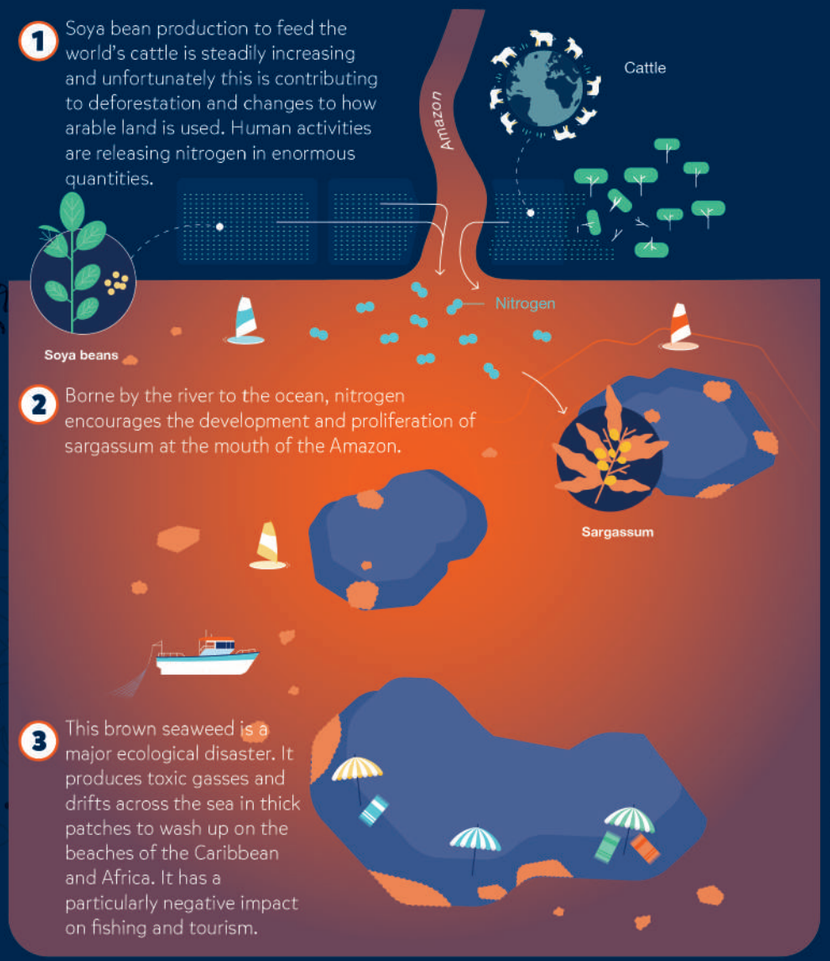
Did you know that there are billions of bacteria and fungi in your intestines? Yummy! We call them "microbiota" or "gut flora". Every human being is home to billions of microorganisms which feed on... what our bodies digest! In exchange, they protect us from harmful bacteria that can make us ill. It is only recently that scientists have come to understand the importance of gut bacteria for our health, our digestion and even our behaviour! It just goes to show that sharing is good for you.

WHAT CAN WE DO TO PROTECT THE OCEAN?

We can do lots of things to help protect the oceans and the entire planet. Learning and keeping informed are the first steps.
Scientists remind us of how important it is to understand how the oceans function so we know what to do. Every choice we make is important and can impact another region of the world.

IT'S HAPPENING RIGHT NOW!

You have probably heard of "sargassum", a type of seaweed which is prevalent along the shores of the Caribbean. It is a fine example of the connection between humans, land and sea. Let's take a closer look.



1. Soya bean production to feed the world's cattle is steadily increasing and unfortunately this is contributing to deforestation and changes to how arable land is used. Human activities are releasing nitrogen in enormous quantities.
2. Borne by the river to the ocean, nitrogen encourages the development and proliferation of sargassum at the mouth of the Amazon.
3. This brown seaweed is a major ecological disaster. It produces toxic gasses and drifts across the sea in thick patches to wash up on the beaches of the Caribbean and Africa. It has a particularly negative impact on fishing and tourism.

Illustrations: Anaïs Chevret. Infographics: Studio v2.

MARINE MICROORGANISMS

1 LITRE of seawater contains between 10 billion and 100 billion microorganisms. They vary in size from 0.01 micrometre to 1 cm, which is like comparing the size of an ant to that of a brontosaurus!

Microorganisms account for 95 % of all the life in the Ocean,

the remaining 5 % being arthropods, fish, etc.

THE INVISIBLE PEOPLE OF THE OCEAN

Marine microorganisms are the origin of life on Earth. They are essential to the balance and health of the oceans, and to the rest of the planet too.

THE OCEAN, THE KEY TO LIFE ON EARTH

The Ocean plays several key roles in our planet's health:

Use the percentages to colour the space taken up by the Ocean in blue and the land in green.

THE GREAT REGULATOR:
The Ocean regulates the world's temperature and through plankton, it generates oxygen (O_2) and stores carbon dioxide (CO_2) too.

SOURCE OF LIFE: The Ocean covers about 71% of the world's surface and is home to 99% of living things on Earth.

THE OCEAN AND HUMANS ARE CONNECTED

The Ocean is GIGANTIC AND EXTRAORDINARY, breathe and feeds much of the world. But it is it makes our planet habitable, enables us to very fragile.

Colour the Ocean and its inhabitants with your best crayons!

And tell us about your connection to the sea and its inhabitants, and how you want to protect them!

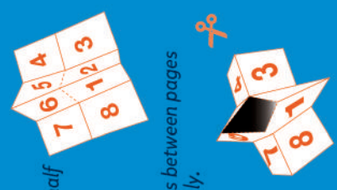
This Mini-Mag belongs to

On the cover draw a picture about your connection to the Ocean.

Fondation tara océan

TUTORIAL: MAKE YOUR OWN MINI-MAG

1. *Cut the page along the dotted lines.*
2. *Fold the page in half three times.*
3. *Cut along the lines between pages 1& 2 and 5 & 6 only.*
4. *Fold it in half again.*
5. *Bring the two edges together to make a star.*
6. *Your Mini-Mag is ready!*



Illustrations: Anaïs Chevret.

Fondation
tara océan
explore and share

Fondation tara océan
20 YEARS
OF COMMITMENTS

We all have a good reason to protect the Ocean.

Explore to understand. **Share** to change.

Learn more at
www.fondationtaraocean.org

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TO HELP KEEP
THE WIND
IN OUR SAILS

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