

SECOND  
EXTENDED  
EDITION



# Ocean Challenge



*Malizia*  
#MYOCEANCHALLENGE



seaexplorer

# Come, let's sail around the world and explore the Ocean



PIERRE CASIRAGHI

BORIS HERRMANN

## Our Ocean Challenge

Dear children, parents, teachers and adventure lovers!

We combine sailing, science and education. We can feel the effects of climate change in the Ocean and want to share our research and knowledge on these issues with you.

We are in a race against other teams in our sailing races, but we all face a race against time with the challenge of finding solutions to combat climate change. We invite you to experience our exciting sailing adventures live and to gain an insight into ocean research through our sailing yacht. We have developed this international school programme for 9-14 year-olds to bring ocean-related topics to schools worldwide and to raise awareness of ocean issues and climate change. UNESCO refers to this as ocean literacy. We want to support UNESCO with this goal. We would be very happy to have you with us and look forward to hearing from you.

You can contact us at [myoceanchallenge@borisherrmannracing.com](mailto:myoceanchallenge@borisherrmannracing.com).

Pierre Casiraghi - Team Founder

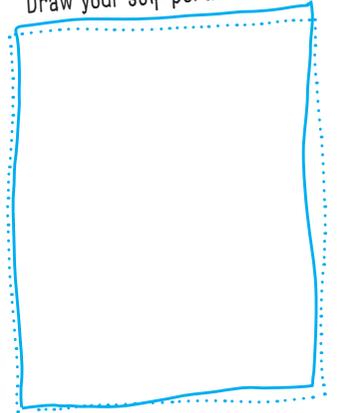
Boris Herrmann - Vendée Globe Skipper

## ACTIVITY *Become a part of the OCEAN CHALLENGE Team!*

- Sign on with Team Malizia!
- Introduce yourself in a personal profile, so that the team can get to know you better!
- Think about what you can do for the Ocean - what is your Ocean Challenge?



Draw your self-portrait here!



ME: .....

Age: .....

Where I live: .....

My dream job: .....

What I like doing: .....

Things that are important to me: .....

Things I know a lot about: .....

I dream about: .....

Favourite food: .....

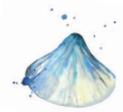
My favourite place in the world: .....

My Ocean Challenge: .....





# The following topics await you



## STAGE

### 1

## We love the Ocean. The Sailing Adventure.

- 06 Our Vendée Globe dream
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## STAGE

### 3

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- 45 My design
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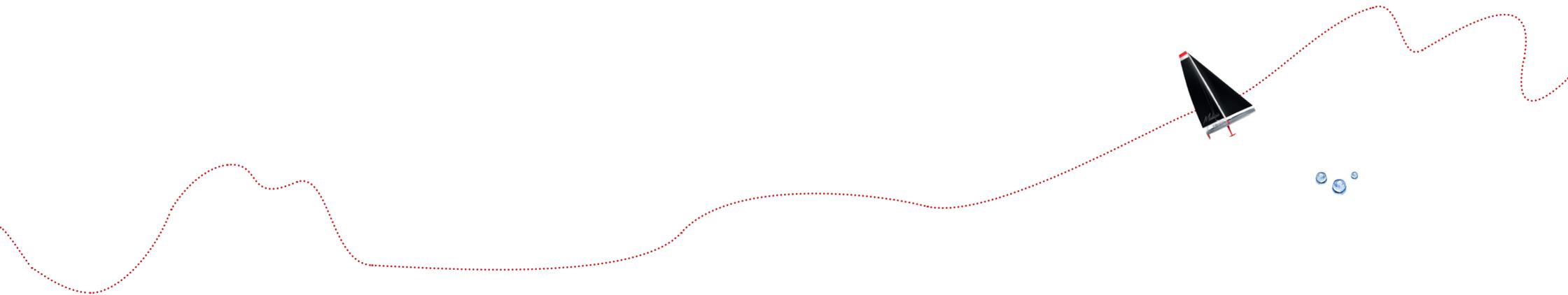


## The Ocean Challenge Team

As well as professional sailors, our team includes boat builders, technicians, scientists, teachers and team managers.

= Expert pages







STAGE  
1

We love the Ocean. The sailing adventure.



# Our Vendée Globe dream

Pierre and Boris are passionate yachtsmen and adventurers. They met during a race across the South Atlantic in 2013 and have been good friends ever since. They also hold the record for this route, at 10 days and 18 hours. With TEAM MALIZIA they have been sailing the world's oceans since 2017.

Boris has already circumnavigated the globe several times in races, won a round-the-world race and holds several world records. In January 2021, he completed one of his life's dreams: the VENDÉE GLOBE RACE. It is a very special event. We call it the "Everest of the seas", and it is one of the toughest challenges imaginable.



**MORE THAN 10,000 PEOPLE** have climbed Mount Everest.



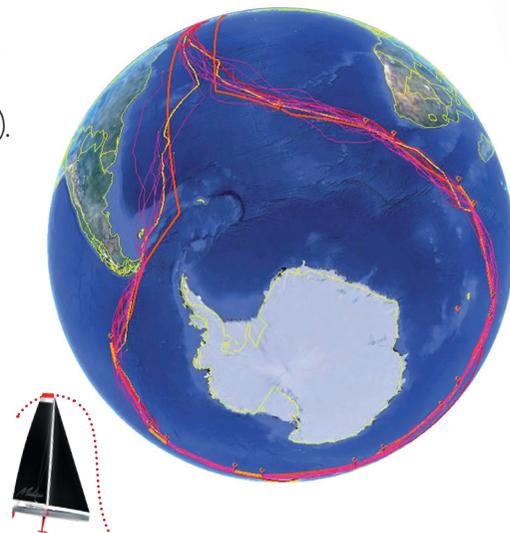
**MORE THAN 500 PEOPLE** have been in space.



**FEWER THAN 100 PEOPLE** have managed to single-handedly sail non-stop around the world.

## The famous Vendée Globe Race

- Started in 1989 and takes place every 4 years.
- The circumnavigation of the world starts and finishes in France.
- Non-stop.
- Completely alone. So just one sailor on board (single-handed).
- No outside help or stops allowed.
- Record 74 days.
- The route is between 46,883 and 52,937 km long, depending on how close the yachts sail to the South Pole.
- The best sailors in the world take part.
- Boris's time during the Vendée Globe was: 80 days 14 hours 59 minutes and 45 seconds



## ACTIVITY

- What is your dream?
- Which friends can help you achieve your dreams?
- What would you like to do when you are older, if money was no object?
- What fascinates you most?
- Are you curious about something?
- What frightens you?
- Can you imagine sailing in such a race starting in the summer holidays and ending in the autumn holidays?
- Would you like to swap places with Boris and sail in such a race?

## Distances sailed by the winners

1990	T. LAMAZOU		47,198 km
1993	A. GAUTIER		46,883 km
1997	C. AUGUIN		49,115 km
2001	M. DESJOYEUX		49,448 km
2005	V. RIOU		49,474 km
2009	M. DESJOYEUX		52,417 km
2013	F. GABART		50,952 km
2017	A. LE CLEAC'H		50,847 km
2021	Y. BESTAVEN		52,937 km

# Now-stop, single-handed around the world

## THE NINTH VENDÉE GLOBE

- Start: 8 November 2020
- Boris's arrival: 28 January 2021
- Boris, the first ever German to take part
- 33 boats from 8 countries, 6 women

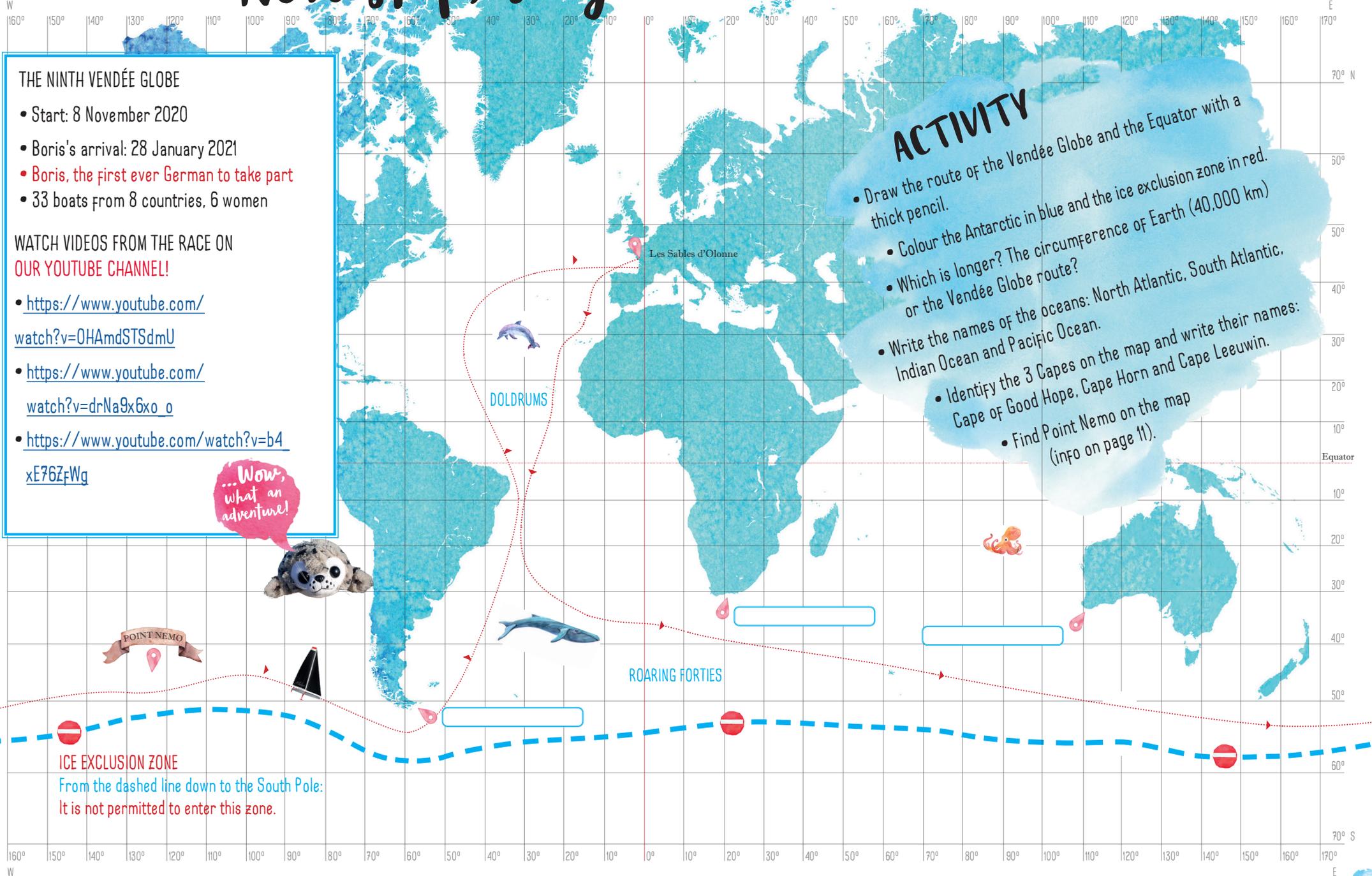
WATCH VIDEOS FROM THE RACE ON  
OUR YOUTUBE CHANNEL!

- <https://www.youtube.com/watch?v=0HAMdSTSDmU>
- [https://www.youtube.com/watch?v=drNa9x6xo\\_o](https://www.youtube.com/watch?v=drNa9x6xo_o)
- <https://www.youtube.com/watch?v=b4xE76ZFwg>

...Wow, what an adventure!



**ICE EXCLUSION ZONE**  
From the dashed line down to the South Pole:  
It is not permitted to enter this zone.



## ACTIVITY

- Draw the route of the Vendée Globe and the Equator with a thick pencil.
- Colour the Antarctic in blue and the ice exclusion zone in red.
- Which is longer? The circumference of Earth (40,000 km) or the Vendée Globe route?
- Write the names of the oceans: North Atlantic, South Atlantic, Indian Ocean and Pacific Ocean.
- Identify the 3 Capes on the map and write their names: Cape of Good Hope, Cape Horn and Cape Leeuwin.
- Find Point Nemo on the map (info on page 11).

# Our racing yacht



VIDEO: MALIZIA - SEAEXPLORER in action!

<https://www.youtube.com/watch?v=iYYt0FNuO-M&t=41s>

MALIZIA - SEAEXPLORER is an extremely fast racing yacht. With its red wings (foils) it can almost fly. They act like hydrofoils in the water and raise the boat up.

To make the boat as light as possible, but still stable, they are built using carbon fibre.

MALIZIA - SEAEXPLORER is an IMOCA 60 (International Monohull Open Class Association, 60 foot long) class boat. This class of boat is used by sailors to go around the world in the VENDÉE GLOBE RACE.

Many designers, engineers, and boat builders have worked hard to create such a fast boat. A total of 80,000 hours of work have been put into the boat.



- Name: Malizia - Seaexplorer
- Length: 60 feet (18.3 m) - approx. 5 cars
- Mast height: 27 m - 6 double-decker buses
- Weight: About 9 white sharks
- Biggest sail: 400 m<sup>2</sup> - about the size of a basketball court
- Max. speed: Up to 40 knots (75 km/h) - faster than a leopard



## ACTIVITY Match together!

- Write the number by the right place on the boat:  
1 = Foil | 2 = Keel | 3 = Bow | 4 = Stern | 5 = Mast | 6 = Foresail
- Create a line of pupils that is exactly the same length as MALIZIA - SEAEXPLORER



# From the smallest to the biggest boat

## Where does the team name MALIZIA come from?

The team is named after FRANCESCO GRIMALDI, who was nicknamed MALIZIA. In 1297, disguised as a Franciscan monk, he captured the famous rock of Monaco on which the Palace of Monaco still stands today. Monaco is where Pierre comes from. MALIZIA gained admission to the palace. However, he had hidden swords under his monk's robe. That is how he captured the rock at night.

MALIZIA translates as: "THE SLY ONE", "THE CUNNING ONE". Proceeding with cunning and a specific strategy can also be an advantage when sailing.



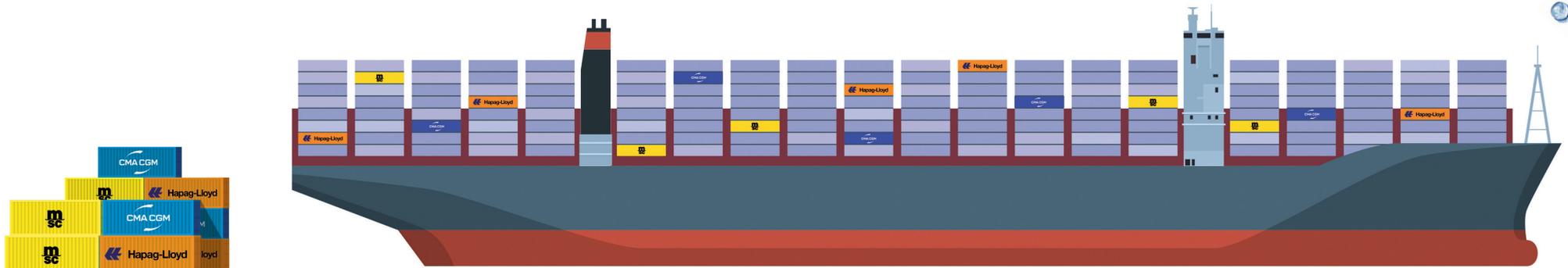
OPTI  
 2.36 m  
 35 kg  
 4-5 kn



IMOCA 60  
 18.28 m  
 40 kn



DEEP SEA TRAWLER  
 20-30 m  
 29,000 kg  
 13.6 kn



20,000 TEU CONTAINER SHIP  
 396 m  
 218,768,000 kg  
 16 kn



# Seaexplorer then and now...



## SEAFARERS OF THE PAST



"What is beyond the horizon? Are there other lands and coasts?"



### CHRISTOPHER COLUMBUS: THE DISCOVERER OF AMERICA

Columbus actually wanted to find a new sea route to India. But on **12 October 1492**, Columbus, with his three sailing ships, **was the first European to set foot in America**. He studied ancient writings and nautical charts, and as he read, he had a vision of a great adventure. Right up until the end, Christopher Columbus found it hard to believe he had discovered a new continent. On 3 August 1492, Columbus started the journey with three ships, caravels that could sail into the wind: SANTA MARIA, PINTA AND NIÑA.

"Land was sighted at 2 am. We waited until dawn, which was a Friday, and arrived at an island," wrote Columbus in his logbook – not knowing that he had just discovered America.



### MAGELLAN: THE FIRST PERSON TO SAIL AROUND THE WORLD

The Portuguese sailor Ferdinand Magellan (1480-1521) was **the first to discover a sea route to India** via South America. Some time after passing around the continent's southern tip – an area now called **THE STRAIT OF MAGELLAN** – he reached the Philippines after crossing the Pacific.

His journey **proved that the world was round**. Magellan is recorded in the history books as the first person to circumnavigate the world.

## Hightech yachts

There are now ultra-modern racing yachts that you can sail non-stop around the world on your own. And they can do this even faster than Jules Verne did in his book "Around the World in 80 Days".



### SANTA MARIA:

Maximum speed **9 knots**, average **2-3 knots** for the voyage around the world.



### MALIZIA - SEAEXPLORER:

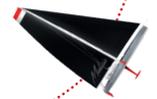
Speed up to **40 knots**, average **16 knots** for the voyage around the world.

**1 knot = 1.852 km/h**  
With its foils, huge sails and light weight, SEAEXPLORER can sail even faster than the wind!



### TRICKY QUESTION:

Discuss in your class why you can't travel around the world non-stop in a motorboat?





Space for my thoughts & ideas



## EXPERIMENT

*Do you know why a boat floats?*

The ancient Greek, Archimedes, knew this in 300 BC.

**GIVE IT A TRY** You need: a BOWL, WATER and some PLASTICINE.  
Create a large, flat, slightly curved hull and place it in the water!



## EXPERT KNOWLEDGE

The weight of the hull is less than the weight of the water, which it displaces with its shape. That is why it does not sink!





# SEAEXPLORER - The spaceship

## What is it like to live on MALIZIA - SEAEXPLORER?



Life on board MALIZIA - SEAEXPLORER is similar to life on board a spaceship. The preparation for races on MALIZIA - SEAEXPLORER is like preparing for a space mission.



### Food



Planning the food is very interesting. Boris and Pierre eat "astronaut food", i.e. freeze-dried food. This is powder that is then mixed with water. Fresh water is extracted from salt water on board, using a water-maker. This saves weight!

By the way, it is not always easy to prepare food when the boat is listing heavily. The food packages are divided up precisely in advance and calculated for each day.



### Science



The boat also has a laboratory, with which ocean data such as CO<sub>2</sub> can be measured. Boris, Pierre and the team help scientists to further explore the Ocean and learn more about climate change (there is more information about this in stage 2).



### Communication with the outside world



How is information, data and pictures sent from the boat to land? These days, news, pictures, weather data, navigation data and ocean measurement data can be sent via satellite.

**Boris gives you live reports about the adventures he is experiencing on MALIZIA - SEAEXPLORER** and the effects of climate change he observes. Get in touch with him, write emails to him and invite him to your classes. Many classes have already been on board, sailed with us and explored the boat.

### Point Nemo



Would you like to be really alone, at the most isolated point on Earth?

Then POINT NEMO is the perfect place for you. Become an expert with these 5 facts!

POINT NEMO is located between Chile and New Zealand and is the point furthest from any land (2,688 km) For comparison: the ISS space station orbits at a distance of 408 km above Earth.

The point was only "discovered", i.e. calculated using a computer programme, in 1992.

The point was not named after the famous cartoon fish, but after Captain Nemo, a character from Jules Verne's novel "Twenty Thousand Leagues Under the Sea" POINT NEMO is a biologically "inactive location" and is so far away from land that hardly any nutrients get there.

The exact coordinates are: 45°52.6S, 123°23.6W (see map of the world on page 6).



# Life on board

## Sleeping in a bunk



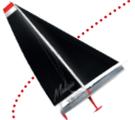
This is Boris's bed – a mat that can be moved up and down with a cable pull when the boat lists (tilts over). But how can Boris sleep if he has to sail single-handed for almost 3 months without stopping? Boris sleeps for no more than 60 minutes at a time, then he has to take a look around and check that the sails are set correctly. While he sleeps, a computer, the "autopilot", is set so that MALIZIA - SEAEXPLORER heads in the right direction. The famous painter and inventor Leonardo da Vinci (1452-1519) also apparently slept for only 15 minutes every 4 hours. And dolphins also have a trick when it comes to sleeping: they let just one side of their brain sleep and the other side stays awake. This allows them to keep breathing and surface.



## Working on the computer



This is Boris in his small "office". Here he can make calls using a **satellite telephone**, send emails, receive weather data and navigate.



## Clothing



Whether near the Antarctic or in the tropics, sailors need special clothing for extreme weather conditions to protect them against the heat, the cold and wet conditions.

There is also a survival suit that is waterproof and prevents the wearer from sinking. It looks like a space suit!



## ACTIVITY Reporter

Imagine being a **REPORTER ON MALIZIA - SEAEXPLORER**, sailing from the autumn holiday to the winter holiday (approx. 3 months) without a break and sending reports from on board. It feels like you're on a roller coaster ride in a spaceship.

### WRITE AN EXCITING REPORT!

THESE QUESTIONS MAY HELP YOU: What do you experience?  
What is your daily schedule?  
What makes you happy? What frightens you?

THESE KEYWORDS MAY HELP YOU: eating, sleeping, clothing, hygiene, storms, waves, pirates, measuring ocean data, observations in the sea...

## Hygiene



There is no toilet, just a bucket! Salt water is used for washing.



# Challenges at sea

SAILING ON THE HIGH SEAS BRINGS MANY CHALLENGES. It means facing the full force of nature with much courage and perseverance.



**SUN:** The sun can be particularly strong in the tropics and lead to sunburn. Sailors have to protect themselves well with clothing and often sweat a lot.



## What springs to mind?

**COLD:** The cold can also be a challenge. Imagine being on the boat in the very cold regions without heating. Brrrr... Fortunately, we can use specialist clothing that provides good protection against the cold.



**STORMS:** The wind can blow at speeds of up to 50 knots, which is almost 100 km/h, creating huge waves. This makes things difficult for sailors, and can sometimes be dangerous.

**HUGE WAVES:** How high do you think the biggest wave was that MALIZIA - SEAEXPLORER has faced? Our sailors may encounter waves of up to 12 metres – as high as a four-storey building.



## EXPERT KNOWLEDGE



**DOLDRUMS:** This strange name refers to an area that is often a real challenge for sailors. The area is located around the Equator. It generally has very light shifting winds and calm conditions, but also unexpected gusts and thunderstorms.

**ROARING FORTIES:** This is the area between the latitudes of 40° and 50° South. The wind is extremely strong here, and sailors often have to deal with gale-force winds (see the map of the world on page 6).



**PIRATES:** Pirates can be a threat to sailors. In the past, the sailing routes of other races have actually been moved so as not to pass through pirate areas, or boats have been escorted by security services.



**ICEBERGS:** MALIZIA - SEAEXPLORER will also sail close to the polar region. The sailors have to be extremely careful not to collide with icebergs or pieces of ice floating under water. Satellite imagery, radar and a good eye help avoid such crashes.



**FAR FROM HELP:** In the Southern Ocean in particular, help from other people is extremely far away – even further than the ISS space station is from Earth!



# ACTIVITY

• You are a Marine Researcher and discover a new animal or plant species! Perhaps a hybrid or a bizarre plant ...

(drawing, painting, collage)



# SEAEXPLORER'S companions



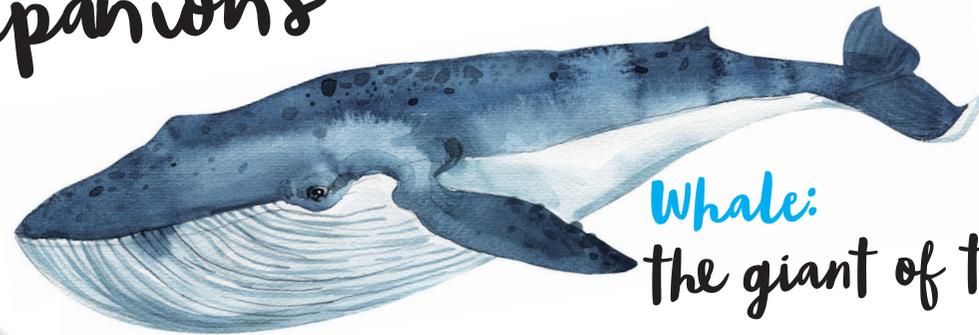
## Albatross: the faithful soul

- Giant among the sea birds
- At home in the southern hemisphere.
- Often flies close to MALIZIA - SEAEXPLORER to take advantage of updraughts, allowing it to stay in the air and travel along with no effort.
- Wingspan of up to 3.5 m (approx. 3 school desks)
- Faithful lovers: only one partner during their lifetime. Dynamic gliding, even in storms
- Can fly extremely long distances
- Good swimmer due to webbing between its toes



## Dolphin: the intelligent playmate

- Often visits and accompanies MALIZIA - SEAEXPLORER
- Plays with the waves and the boat
- Not a fish, but a mammal
- Big brain, very intelligent
- Good sense of hearing and smell
- "Sees" using ultrasound and can also see small things clearly from a distance of 30 m
- Can hear echolocation signals from other dolphins and knows what they are seeing
- Uses loud noises to train the young and drive away sharks
- Scientists are trying to decipher the code of a possible dolphin language so that they can communicate with them.



## Whale: the giant of the seas

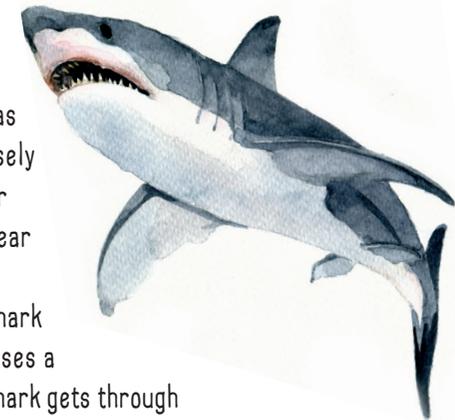
Sometimes while at sea Boris and Pierre will see a huge tail fin or a large fountain of water: this means there is a whale in the vicinity of MALIZIA - SEAEXPLORER.

- Biggest whale: blue whale - maximum length 33 m (about 8 cars)
- Instead of teeth: baleen; plates made of keratin that hang down and filter plankton (small crustaceans or krill) and small fish
- Eats one tonne per day
- Fountain when exhaling: maximum 10 m (around 2-3 cars). The air from one breath could be used to inflate 2,000 balloons!

## Shark: the hidden companion

Boris has only seen a shark once. Sharks usually stay under water and are not visible from MALIZIA - SEAEXPLORER.

- This predatory fish is afraid of humans and rarely shows itself
- Has existed for longer than dinosaurs, over 100 million years
- Closely related to the whale
- 10-50 people are attacked by sharks per year
- Around 100 million sharks are killed by humans every year
- Many shark species are threatened by extinction
- The whale shark, at a length of almost 14 m, holds the record size for a shark
- Maximum speed of 70 km/h by the mako shark
- If a shark loses a tooth, it is replaced by a new one in just a few hours! A tiger shark gets through



## ACTIVITY

Which facts about the animals surprised you?  
Write down what you think and compare with your classmates.

1,400 teeth over the course of 10 years! If a fish moves, sharks can hear this from a distance of 650 m and can be at the scene in 20-40 seconds!

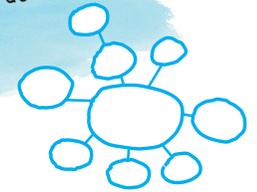


# Plastic in the Ocean



## ACTIVITY

You can also make a contribution by trying to avoid generating plastic waste.  
Create a mind map: What can I do?  
Avoid, reuse, recycle ...



Plastic waste ends up in our Ocean and it can take up to 500 years to disappear again. More than 8 million tonnes of plastic ends up in the Ocean every year. Plastic may be mistakenly eaten by animals or can cause them to suffocate or drown if they get entangled in the plastic waste. The sun breaks the plastic down into tiny particles, which are called microplastics. These particles are then eaten by fish and enter the food chain. We humans can experience health problems if we eat marine creatures that have microplastics in them. The Mediterranean is particularly polluted. There are 300 trillion microplastic particles there!



## Clever minds

There are lots of great programmes that are helping to explore and protect the seas, and to get to grips with the problem of plastic in the Ocean.



## Beyond Plastic Med

This organisation is very involved in exploring the sea and finding solutions to the problem of plastic waste in the Mediterranean.

→ [beyondplasticmed.org](http://beyondplasticmed.org)



## Monaco Ocean Week

Every year, Pierre's home country of Monaco holds "Monaco Ocean Week" For a whole week, scientists from all over the world come together to develop ideas for protecting the Ocean and to present new solutions.

→ [monacoceanweek.org](http://monacoceanweek.org)



## Alliance to End Plastic Waste

The Alliance to End Plastic Waste wants to clean the rivers via which most of the plastic gets into the Ocean. It is also developing recycling opportunities in poor countries such as Indonesia, and new technologies.

→ [endplasticwaste.org](http://endplasticwaste.org)



Space for my thoughts & ideas





STAGE  
2

We research the Ocean and their  
role for the climate.



# Curiosity about the Ocean

We spend a lot of time at sea and notice changes.



"It feels like there are fewer sea birds in the North Atlantic - can that be the case? Is the wildlife changing due to global warming?"

"On the trip with Greta Thunberg across the Atlantic, we had to deal with four tropical storms. Why was that? Is climate change resulting in more storms?"

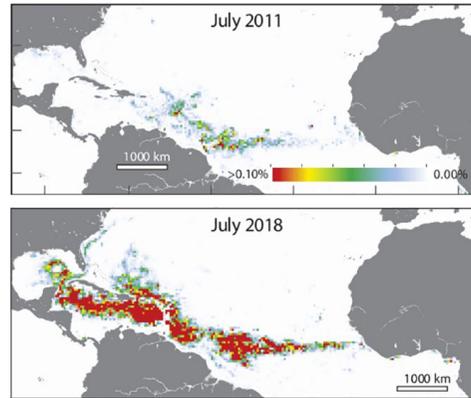


"Finally, a break in the middle of the Ocean! I've never seen such a strange boat before!"



"I sometimes see huge fields of seaweed on the sea. These actually slow the boat down. They can also be seen on satellite images. Look at this. The sea has really changed in the last ten years!"

Seaweed gets stuck everywhere on the boat in the trade wind regions.



## Are we observing the effects of climate change?

It is not yet known exactly why these large seaweed fields arise and what exactly influences them. It most likely has something to do with climate change. More research is needed.

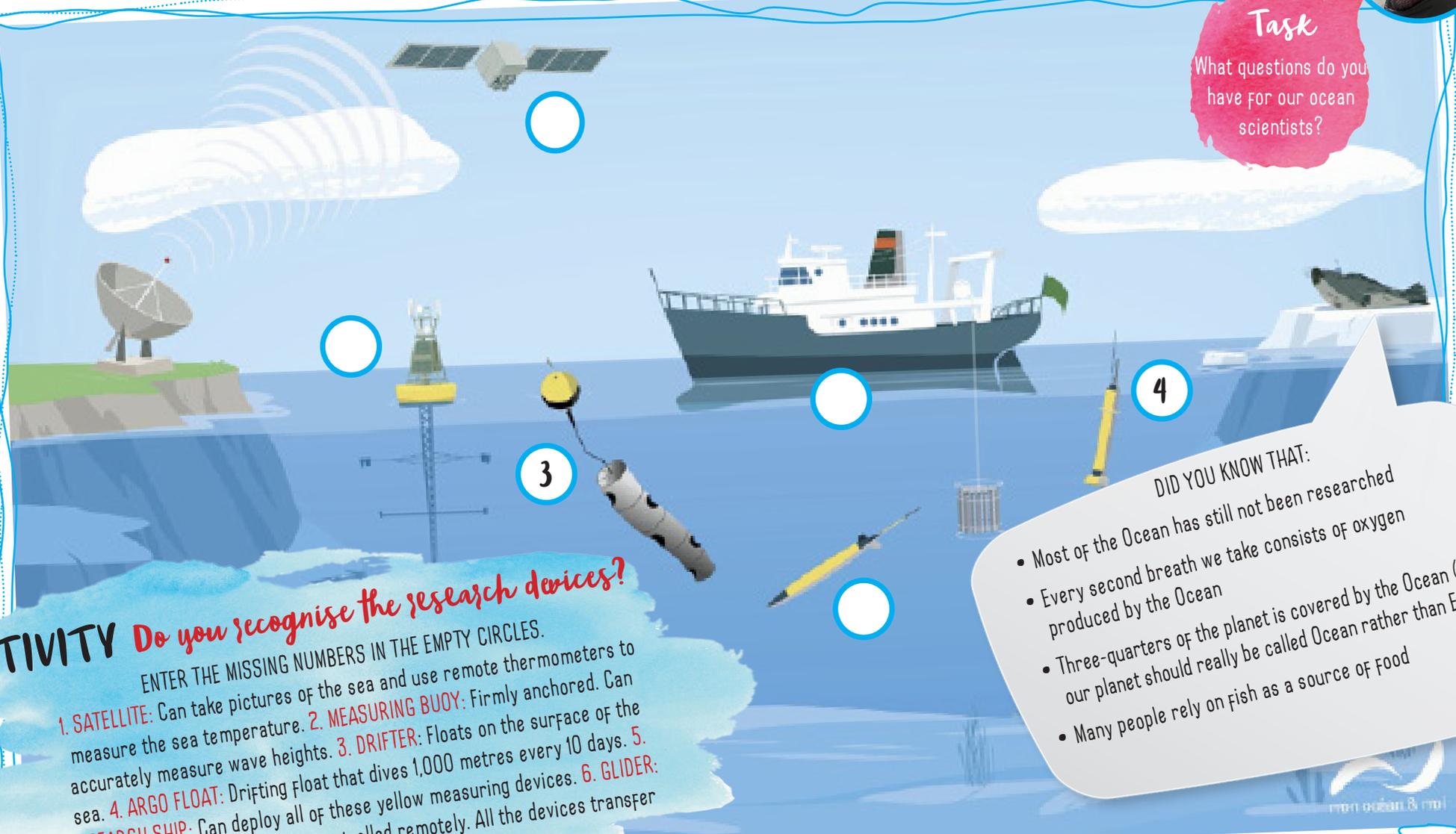


# How is ocean research done?



## Task

What questions do you have for our ocean scientists?



## ACTIVITY Do you recognise the research devices?

ENTER THE MISSING NUMBERS IN THE EMPTY CIRCLES.

**1. SATELLITE:** Can take pictures of the sea and use remote thermometers to measure the sea temperature. **2. MEASURING BUOY:** Firmly anchored. Can accurately measure wave heights. **3. DRIFTER:** Floats on the surface of the sea. **4. ARGO FLOAT:** Drifting float that dives 1,000 metres every 10 days. **5. RESEARCH SHIP:** Can deploy all of these yellow measuring devices. **6. GLIDER:** Underwater glider that can be controlled remotely. All the devices transfer their data to land via satellite.

**DID YOU KNOW THAT:**

- Most of the Ocean has still not been researched
- Every second breath we take consists of oxygen produced by the Ocean
- Three-quarters of the planet is covered by the Ocean (so our planet should really be called Ocean rather than Earth).
- Many people rely on fish as a source of food

Graphic: mon océan & moi / Institut de la Mer de Villefranche



# Famous scientists and ships

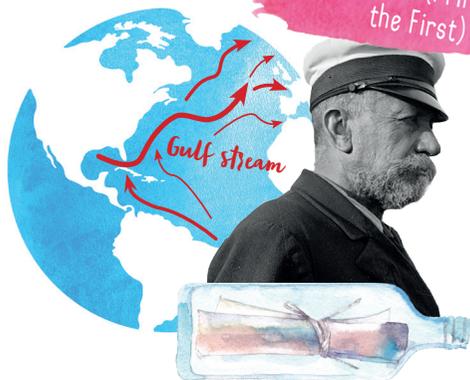


The research ship run by Prince Albert the First of Monaco. Visit the website of the Oceanographic Museum in Monaco:



<https://musee.oceano.org/en/>

"We must understand the Ocean in order to be able to protect it." (Prince Albert the First)



## Message in a bottle

Pierre's ancestor, PRINCE ALBERT I OF MONACO, wanted to measure ocean currents in 1885.

He released 1,000 bottles and barrels containing notes in 10 languages. These asked the finder to mark the location on a

map and report it. There were actually responses from about a quarter of the messages in bottles. The evaluation showed the approximate course of the Gulf Stream. It flows from the Gulf of Mexico across the Atlantic to north-western Europe. The Gulf Stream transports warm water from the sunny tropics to the cold poles. The Gulf Stream has superpowers: it transports more water than all the rivers on our planet combined!



Largest French research ship.



Check whether one of the French research ships is near MALIZIA - SEAEXPLORER and what the wind strength is there.

<https://www.flotteoceanographique.fr>



German research ship. Currently on a major expedition in the Arctic. You can follow this online at <https://follow.mosaic-expedition.org>



## ACTIVITY

- Write a message in a bottle for the Ocean!

## World's oldest message in a bottle

You might have read about this recently in the newspaper?

The world's oldest message in a bottle originated in Hamburg and was thrown from a German boat into the Indian Ocean 132 years ago. A couple recently found it on an Australian beach. What an exciting find! Where had it been for all those years?



# Our scientific friends

As part of the IMOCA racing boat class, TEAM MALIZIA has a partnership with IOC-UNESCO. The Intergovernmental Oceanographic Commission is part of UNESCO and focuses on ocean research and observations. One of its aims is to promote cooperation in ocean research amongst the approximately 150 member states.

Our scientific mission statement is available here:

<https://www.borisherrmannracing.com/wp-content/uploads/2019/03/Malizia-Ocean-Challenge.pdf>

"I am DR. PETER LANDSCHÜTZER, an oceanographer at the Max-Planck-Institute for Meteorology in Hamburg. I research the CO2 cycle in the Ocean. In particular in the Southern Ocean, where Boris sails for a long time during the Vendée Globe, there is currently far too little CO2 data available. So the information he tracks during the races is very valuable and interesting for us scientists and helps us learn much more about the Ocean."



Max-Planck-Institut für Meteorologie

"I am PROF. RALF BRAUNER, a meteorologist. My expeditions to the Antarctic and Arctic have been particularly exciting. In the background you can see my friends. I assist TEAM MALIZIA with questions relating to the climate, weather forecasting and shipping."



"I am MARTIN KRAMP and I work at the UNESCO sub-organisation called JCOMMOPS, where I coordinate the deployment of drifters and Argo floats around the world. I helped organise the partnership between IMOCA and IOC-UNESCO."



"I am DR. TOSTE TANHUA, an oceanographer at the Geomar Helmholtz Centre in Kiel. My area of research is the ocean and climate change. I have been able to persuade professional sailors to collect important data during their races around the world. The picture shows me at the COP climate conference. Have you heard about that?"



GEOMAR

## Would you like to be an Ocean Scientist when you grow up?

- To become an Oceanographer, you need to be interested in science. Oceanography is a specific university degree course. It takes 3-5 years to complete.
- And you need to study for another 2-3 years if you want to get a PhD. In a doctoral thesis, you have to find out something completely new and publish it in specific journals.
- You must be good at English and good with computers.

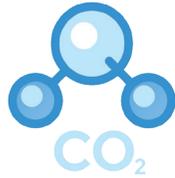
### EXPERT KNOWLEDGE

Meteorologist = Weather scientist  
Oceanographer = Ocean scientist

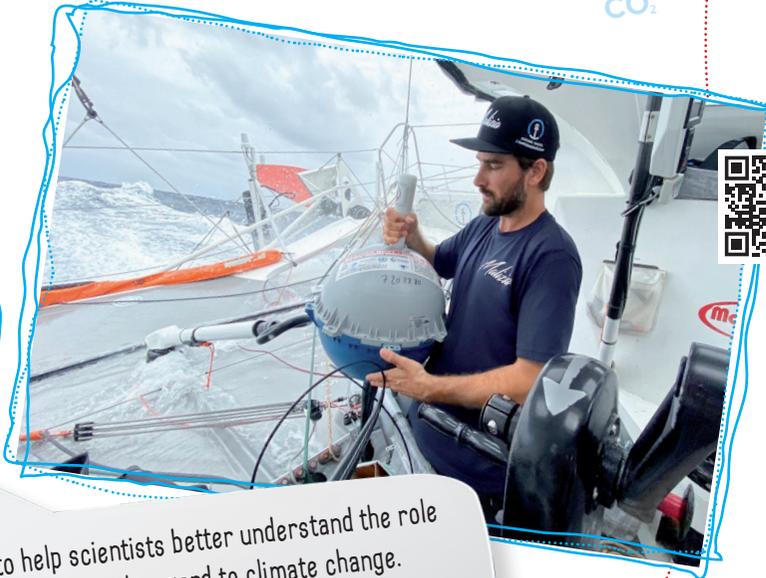


# How we help our scientific friends

"Why do you measure Ocean data on your sailing boat? And what is it that you measure exactly?"



"We want to help scientists better understand the role that the Ocean play with regard to climate change. We use a special sensor to measure important data, such as ocean CO<sub>2</sub>, temperature and salinity."



## ACTIVITY

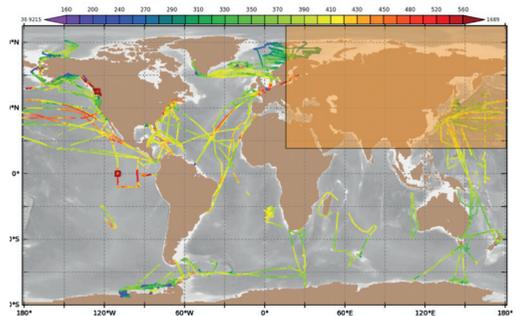


You can see online what data MALIZIA - SEAEXPLORER is currently measuring.  
[www.myoceanchallenge.org](http://www.myoceanchallenge.org)



Watch in the video how we put a UNESCO drifter into the sea at Cape Verde, so that it can collect data: <https://www.youtube.com/watch?v=YfylVvhMWu&feature=youtu.be>

Follow our drifter on the map and see what it is currently measuring: <https://www.jcommops.org>



## Measurements on MALIZIA - SEAEXPLORER

It is not easy to collect Ocean data. You can't just head out to sea and simply start measuring. That's why scientists need boats and ships to measure data in-situ, this data cannot be observed by satellite for example.

There are quite a lot of ships in the Northern Hemisphere – but unfortunately in the Southern Hemisphere there are far fewer. But it is the Southern Hemisphere that has the largest ocean areas, so it is therefore particularly important to collect more data there.

## There are still many gaps in research about the Ocean

The few lines on the world map show you all the CO<sub>2</sub> measurements that were taken during 2019. Some of these were taken by TEAM MALIZIA. There are even large areas, especially in the Southern Ocean, where measurements have never been taken. The picture shows the Surface Ocean CO<sub>2</sub> Atlas (SOCAT) database, where scientists from all over the world can access our measurement data.

# Climate change: the greatest threat to the Ocean?



## EXPERT KNOWLEDGE

### ATMOSPHERE

Earth is surrounded by a protective cover called the atmosphere. It consists of various gases.

### OCEAN

The Ocean covers more than seven-tenths of the surface of Earth, and interact with the atmosphere.

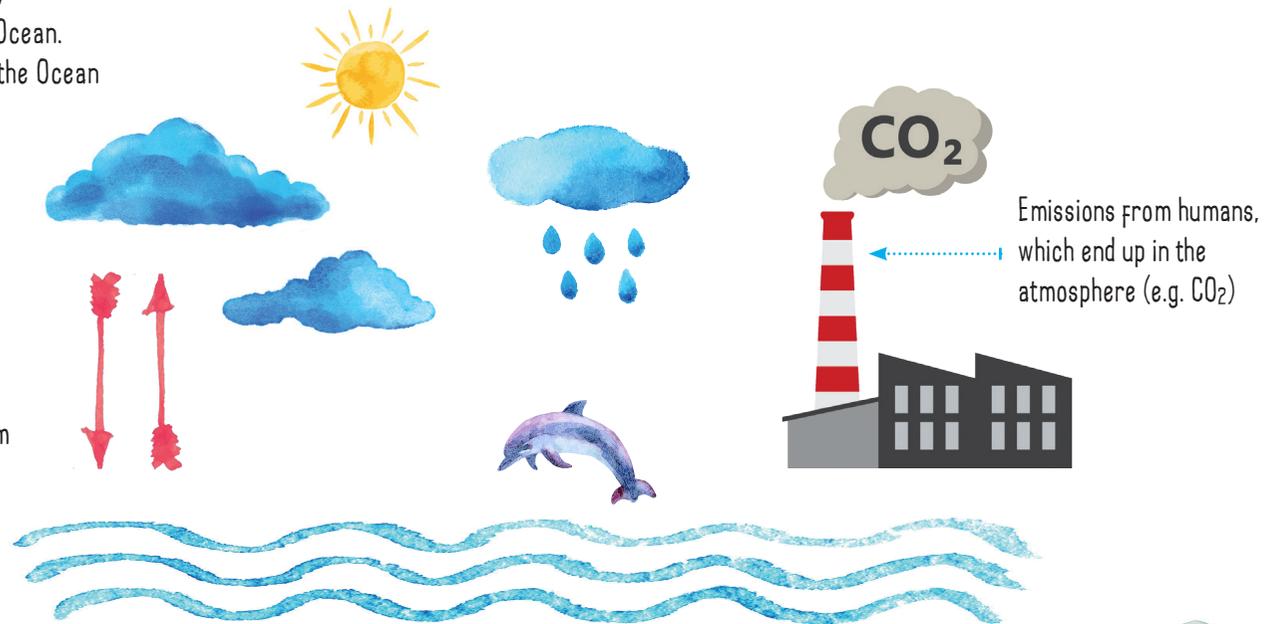


## The ocean and the atmosphere interact with each other

THE EMISSIONS FROM HUMANS GO FROM THE ATMOSPHERE INTO THE OCEAN, because on the surface of the sea the gas can pass from the air into the Ocean. The emissions in the atmosphere lead to global warming. This means that the Ocean also warms up.



THE OCEAN PLAYS A MAJOR ROLE IN CLIMATE CHANGE. The Ocean helps us to cool the Earth and absorb and process emissions from humans. However, this ability is now reaching its limits and is in danger.



# Earth has a fever

## Climate change in brief

Look closely at the picture. This will help you understand climate change. Imagine it is summer and the sun is shining; it gets quite hot in your room. If you are still using a winter duvet, you will be too warm. This is what is happening with Earth. Earth is constantly being heated by the sun. **The atmosphere is like a blanket around Earth. The CO<sub>2</sub> emissions from humans make this blanket even warmer. Earth gets a fever.**

1) The sun is the source of energy for Earth and is the engine of the climate system. It generates warmth on Earth, which allows plants, animals and people to thrive.

5) We humans produce too much CO<sub>2</sub> e.g. as a result of over consumption, driving cars, etc. It is therefore good if we can ride a bicycle more often, instead of driving cars.

### EXPERT KNOWLEDGE

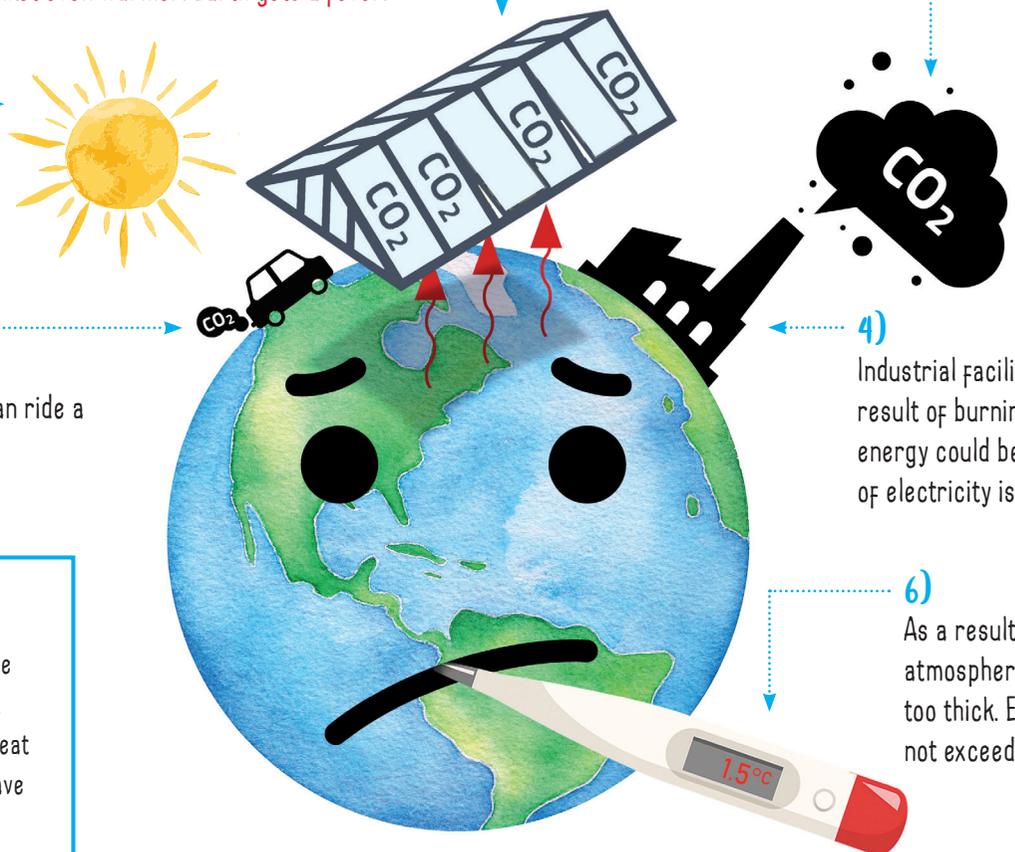
Sun rays are short-wave and therefore pass through the atmosphere and reach the surface of Earth unhindered. They heat Earth. The warm Earth now radiates its own heat back, in the form of long-wave heat rays. These long-wave rays cannot pass through the gases in the atmosphere (in particular CO<sub>2</sub>) so easily. The more CO<sub>2</sub> (and other greenhouse gases) there are in the atmosphere, the less the long-wave heat emitted by Earth can radiate back into space. Which means that Earth gets even warmer.

2) Our atmosphere is a covering made up of a mixture of gases (oxygen, carbon dioxide (CO<sub>2</sub>), methane, ozone, nitrous oxide, etc.) that covers Earth like a blanket. Without this atmosphere, Earth would be very cold at night (minus 140°C) and very warm during the day (plus 82°C). It would be so cold on average that the Ocean would freeze and we would live on an ice planet.

3) CO<sub>2</sub>, a gas, is the main cause of climate change. It is not possible to taste, smell or see it. It leads to warming of the entire Earth.

4) Industrial facilities produce too much CO<sub>2</sub>, e.g. as a result of burning coal in power stations - more wind energy could be used in such cases for example. A lot of electricity is required.

6) As a result of the increased levels of CO<sub>2</sub> in the atmosphere, the blanket around Earth becomes too thick. Earth is getting a fever, which must not exceed 1.5 degrees.



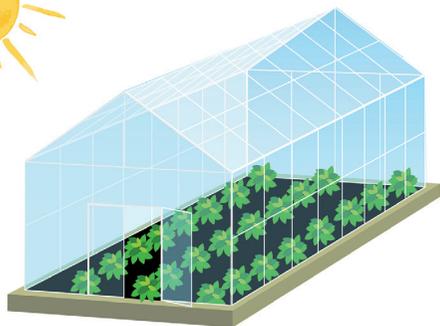
Further recommended reading for teachers is available at: [www.oce.global](http://www.oce.global)

# Greenhouse effect and greenhouse gases



## Why is it called the greenhouse effect?

The glass in a greenhouse works just like CO<sub>2</sub> does in the atmosphere. The glass lets heat from the sun in, but not out again. You can also imagine the inside of a car instead of a greenhouse. If you get into a car that has been in the sun for a long time in the summer, it is much warmer on the inside than it is outside. This is caused by the same effect.



TEST IT IN AN EXPERIMENT →

### EXPERT KNOWLEDGE

#### GREENHOUSE GASES

The gases that cause the greenhouse effect are called greenhouse gases. They prevent the long-wave heat rays reflected by Earth from escaping through the atmosphere unhindered. The most significant of these are (CO<sub>2</sub>), methane, ozone and nitrous oxide.



### EXPERIMENT

**YOU NEED:** two bowls filled with ice cubes and a glass bowl.

Place the two bowls with the ice cubes in the sun. Put the glass bowl over one of the bowls. 3,2,1 GO! Use a stopwatch (e.g. on your mobile phone) to measure how long it takes for the ice in each bowl to melt completely.

What do you observe? Explain Earth's greenhouse effect in your own words.



### DID YOU KNOW...

Another gas is called METHANE, which cattle fart & burp out every 40 seconds! Cattle are therefore real climate destroyers.



# How is CO<sub>2</sub> generated?



If you are driven to school with a petrol-engine car or fly when you go on holiday, CO<sub>2</sub> is produced. The making and transporting of many things that you use every day also generates CO<sub>2</sub>. In the world around you, CO<sub>2</sub> is emitted into the atmosphere almost everywhere: a huge amount of 40 billion tonnes per year. The majority of this comes from the burning of oil, and another significant element is deforestation.



## ACTIVITY

Find examples for specific areas from your life and your surroundings. Look at, for example, the things on your school desk and think about what you most recently bought, how you get to school, how your home is heated, what you last ate...

## The burning of fossil fuels generates CO<sub>2</sub>

Coal, natural gas and crude oil are located underground and were created from "fossils" over millions of years. These "fossil" raw materials, which are stored in the ground (including in the ground under the oceans or the polar seas), are extracted by humans (Latin "fossilis" = dig out). The burning of all these raw materials generates CO<sub>2</sub>. Crude oil is processed into various fossil fuels, which are used to power e.g. cars, planes and ships (e.g. diesel, petrol, kerosene).



## Changes in land use

Trees remove CO<sub>2</sub> from the atmosphere. If we chop them down or burn them, this CO<sub>2</sub> is released over time.

88% of the total emissions  
approx. 34 billion tonnes/year

12% of the total emissions  
approx. 5 billion tonnes/year



Electricity generation in a coal-fired power station  
-> Burn coal  
Electricity generation in a gas-fired power station  
-> Burn natural gas



Manufacturing of products requiring a lot of energy



Building with concrete, e.g. motorways, office buildings. Concrete is made from burnt limestone.



Transportation of things; travel and traffic



# Where does the CO<sub>2</sub> end up?

The Ocean and forests can absorb and convert CO<sub>2</sub>. The remaining CO<sub>2</sub> that cannot be absorbed by the forests or the Ocean accumulates in the atmosphere and remains there for many thousands of years. The amount of CO<sub>2</sub> in the atmosphere therefore increases slowly and "the blanket around Earth gets too warm". This leads to climate change and global warming.

## ACTIVITY

1. Mark significant sources of CO<sub>2</sub>:

- Skateboarding
- Playing computer games
- Leaving lights on
- Watching television
- Turning the heating up to the maximum
- Flying in an aeroplane
- Having a cold shower
- Playing football

2. What do washing machines, TVs, computers, cars and hot water in the bath have to do with CO<sub>2</sub>?  
Explain in your own words.

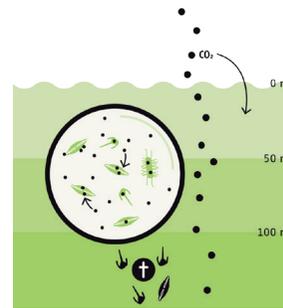


**ATMOSPHERE 47%**



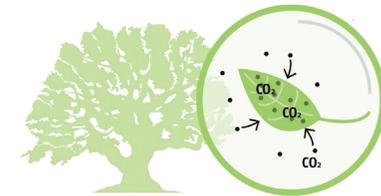
The additional CO<sub>2</sub> produced by humans collects in the atmosphere and is distributed around the whole world.

**OCEAN 23%**



The Ocean absorbs CO<sub>2</sub> where it is converted by plankton.

**FOREST 30%**



Forests absorb CO<sub>2</sub>. CO<sub>2</sub> is converted into oxygen in the leaves.

# Ocean acidification and coral bleaching

## The Ocean absorbs CO<sub>2</sub> at the surface.

Carbonic acid is created when the CO<sub>2</sub> interacts with the water. You probably know of carbonic acid from sparkling water. Of course you don't see bubbles rising in the sea water like in a glass of sparkling water. But a small amount is enough to change the acidity of the sea. **So the Ocean becomes acidic due to the CO<sub>2</sub>. This is referred to as ocean acidification.**

The plants and animals in the Ocean suffer greatly from this acidification. They become sick or die. Since there are fewer and fewer fish as a result, the people who make a living from fishing also have less and less to eat or sell.

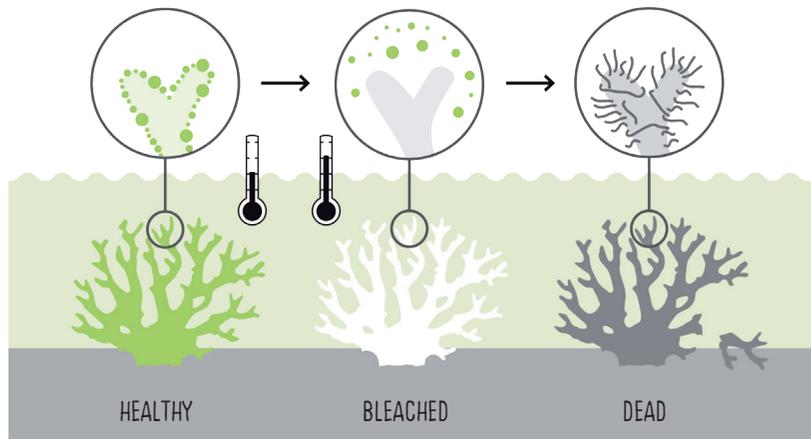
## EXPERIMENT

Cold water absorbs more CO<sub>2</sub> than warm water.  
TEST IT!

Put one bottle of sparkling mineral water (the bubbles are CO<sub>2</sub>) in the fridge and another on the radiator or in the sun. Open both bottles after a few hours.

**WHY IS THIS IMPORTANT?  
IF THE OCEAN GETS WARMER,  
IT CANNOT STORE AS MUCH CO<sub>2</sub>.**

## Coral bleaching



The coral has a connection with certain algae that are crucial for its existence.

If the sea temperature rises by just 1°C, the coral produces a poison that expels its symbiotic partner.

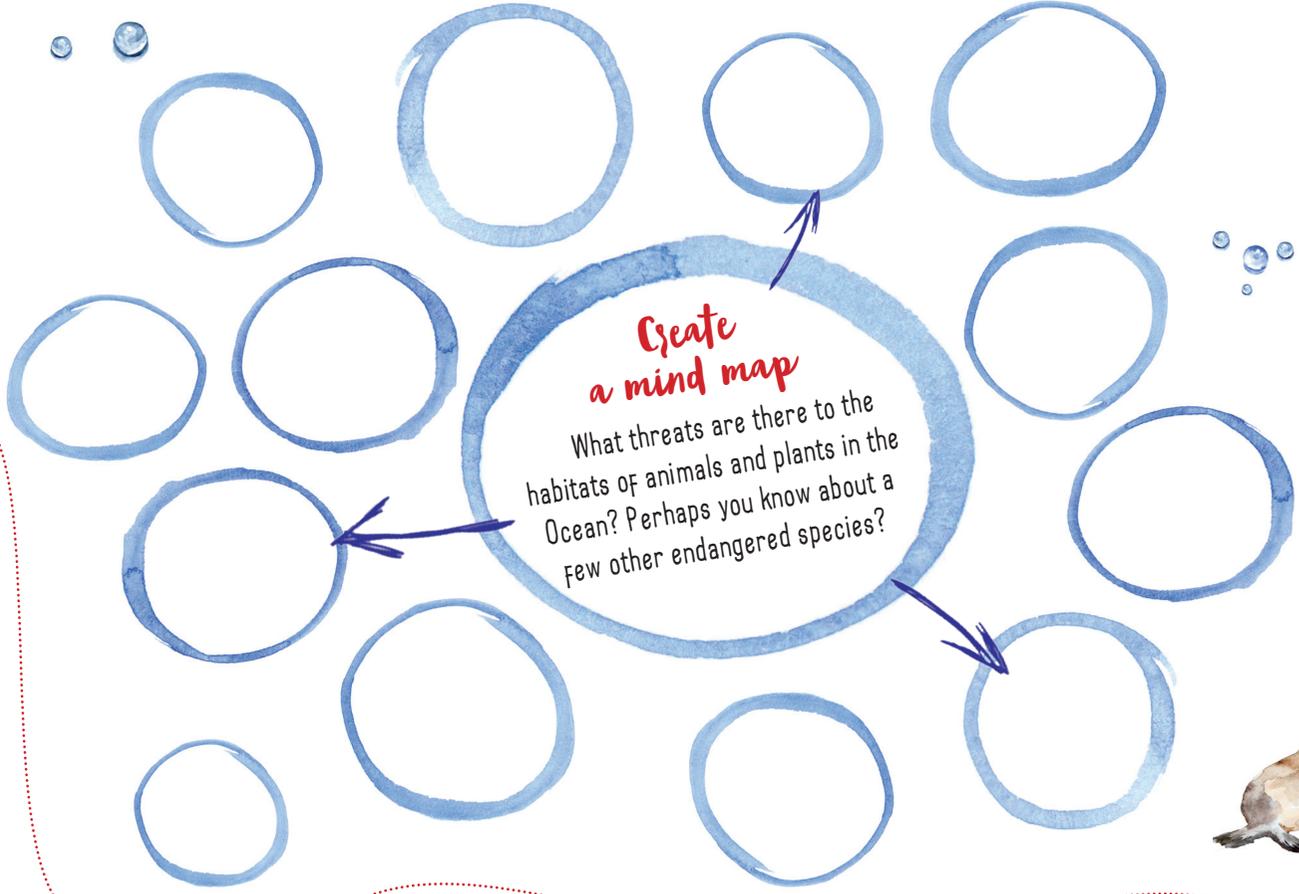
As a result, the coral starves and turns grey...

## Great Barrier Reef, Australia.

Close your eyes and imagine you are diving. You slowly descend into the depths of the Ocean. You are at the other end of the world and dive through a dazzling, colourful underwater world. Colourful fish swim through bright corals... You are fascinated as you observe the fabulous spectacle of colours. It shines, it shimmers, it sparkles! You swim a little further and suddenly the colours disappear. Everything is pale. The corals are grey and white, and you can no longer see any fish. Confused, you surface again. What happened?

The Great Barrier Reef off the north coast of Australia is home to over 350 species of coral and is the ideal habitat for more than 1,500 species of fish and numerous plants. The warming of the sea water and its acidification are resulting in bleaching of the corals, and in the long term their death. If the corals die, the food chain will be disrupted and the fish will also be at risk.

# What threats are there to the habitats of marine animals?



## Female turtle seeks man!



Some reptile species, such as the freshwater turtle, are especially vulnerable to rising temperatures. At temperatures below 28° Celsius, only males hatch from the eggs. At temperatures above 29.5° Celsius, only females hatch. Only in between these two values is there a balanced mix. If the temperature remains permanently too high due to global warming, male turtles will die out; and gradually the whole species as well.

## Adjustment



**3.... 2.... 1.... GO - RACE AGAINST THE CLOCK!**

The decisive factor is not only how strong the effects of climate change are, but also how quickly climate change is progressing. People, animals and plants need time to adapt, then they have a better chance of adjusting to changing conditions. The climate has also changed in past geological eras. But man-made climate change is happening too quickly. Many creatures are overwhelmed by it and fall by the wayside because of the rapid pace of change. It is particularly difficult for animals that are dependent on a specific type of habitat.

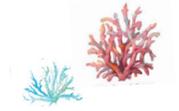


## Why are polar bears so at risk?



In winter polar bears hunt seals. When the ice sheet is intact, the seals have to pop up at holes in the ice to breathe. So that is where polar bears wait for their prey. But because the pack ice is disappearing, polar bears can no longer reach the seals. As the winters get warmer, the feeding season becomes too short.

Starving females have fewer young. They give birth to their young in snow caves. However, these often collapse when it rains. Their winter habitats are now often cut off from their food sources, because the ice breaks up too early due to the warmer temperatures. But the young cannot yet swim very far and therefore often starve to death.



# The consequences of climate change



## THERE ARE NUMEROUS CONSEQUENCES OF CLIMATE CHANGE

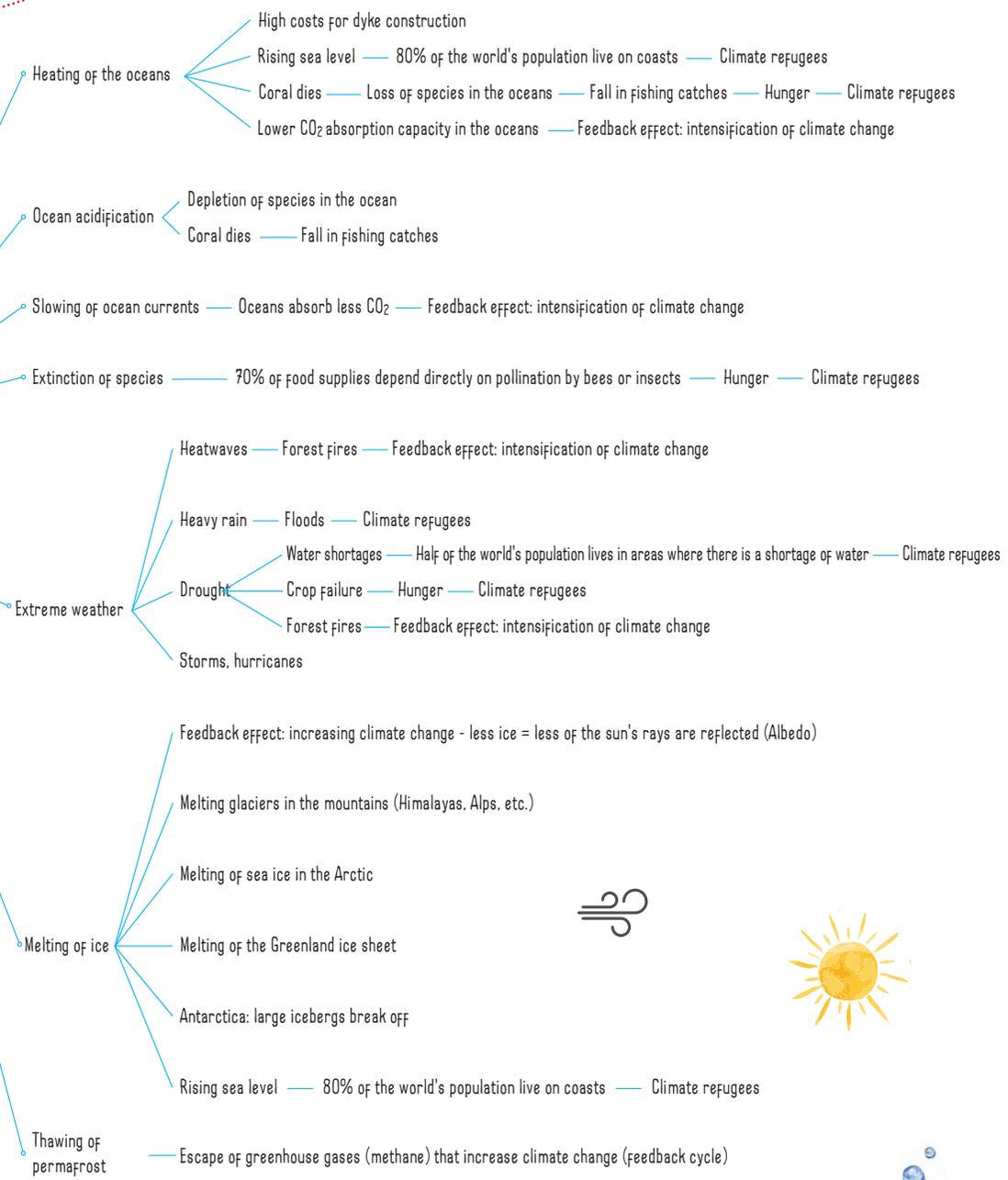
The ice sheets at the poles are melting because our Earth has a "fever". Among other things, this has an impact on the sea level, which continues to rise.

In addition, the water gets warmer and expands. This also causes the sea level to rise. For every centimetre the ocean rises, about a metre of land is lost from the coast. Over half of all people live on coasts!

More water can evaporate from the larger water surface, and thereby gets into the water cycle. Clouds can release rain earlier due to the larger amount of water they carry. This will result in too much rain in some places and almost none in others. People will lose their homes due to rising sea levels, for example in Bangladesh, or due to droughts, such as in Africa, because it rains too little or not at all. Many people will have to flee because of climate change.



### Consequences of climate change



## ACTIVITY

- Take a close look at the individual branches of the mind map in groups.
- Why is it that people have to flee due to climate change?
- Draw the branches that lead to the term "climate refugees" with coloured pencils and talk about them.
- Find out more information about the points of particular interest to you.



## WATCH THIS NASA VIDEO TO SEE HOW THE ARCTIC IS MELTING.

The ice becomes "younger", so is thinner and has a smaller surface area. Half of the ice mass has already melted. <https://youtu.be/Vj1G9gqhkYA>



# The climate must not tip!



Climate change is not a linear process. There are self-propagating effects that can cause Earth's entire ecosystem to reach a "tipping point", the consequences of which are a massive threat to all of humanity. Most of the consequences of climate change cannot be reversed once this tipping point is exceeded.

## IPCC

(Intergovernmental Panel on Climate Change): the IPCC identifies answers to the following questions:

- How can the climate be protected?
- How can people adapt to climate change?
- What are the consequences of climate change?

The aim is to give politicians an overview of ongoing climate research. The IPCC reports are written by hundreds of leading scientists from around the world and have been officially adopted by the governments of the 195 member countries.

The world map on the right shows examples of such self-propagating effects. To avoid exceeding these points, mankind must limit global warming to well below 2°C, ideally to 1.5°C (Paris Agreement). To help ensure this, the CO<sub>2</sub> concentration in the atmosphere must not exceed 450 ppM. In addition, we must not emit more than 350 gigatonnes of CO<sub>2</sub>.

And mankind has to hurry, because 40 billion tonnes of CO<sub>2</sub> are emitted each year and the permitted thresholds will be reached within 10 years (mcc-berlin.net).

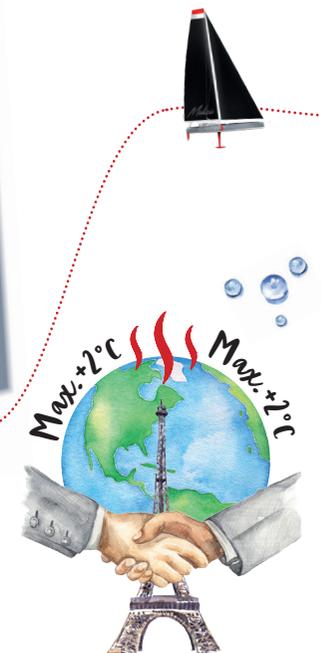
The world must change quickly, so that compliance with these limits can be ensured. This can only be achieved if the whole of mankind can reduce CO<sub>2</sub> emissions by 50% within the next 10 years and to (net) zero by 2050 (ipcc.ch/sr15). Huge changes will be needed over the coming decades to make these reductions. We will look at some of these changes and solutions in the next stage.



[www.oce.global](http://www.oce.global)

## Paris Climate Agreement

195 countries have agreed to limit global warming to well below 2°C, and to make efforts not to exceed 1.5°C if possible.



Space for my thoughts & ideas





STAGE  
**3**



We are creative: new solutions!



# Ready to turn about on climate change!

When a sailor wants to change direction, he or she has to turn the boat about. The helmsman then asks the crew "Ready to turn about?" and when the crew is ready they reply: "Ready!" "READY TO TURN ABOUT ON CO<sub>2</sub>?"... "READY!"

## Unite behind the science!

The Intergovernmental Panel on Climate Change (IPCC) clearly states that more CO<sub>2</sub> will be emitted than our planet Earth can handle. We need to listen to the scientists and make changes: CLIMATE CHANGE NEEDS TO BE REVERSED!

You can start helping the climate by adjusting your behaviour at home and at school. And society can change a lot, by making use of existing solutions and finding new solutions. That is what this stage is about.



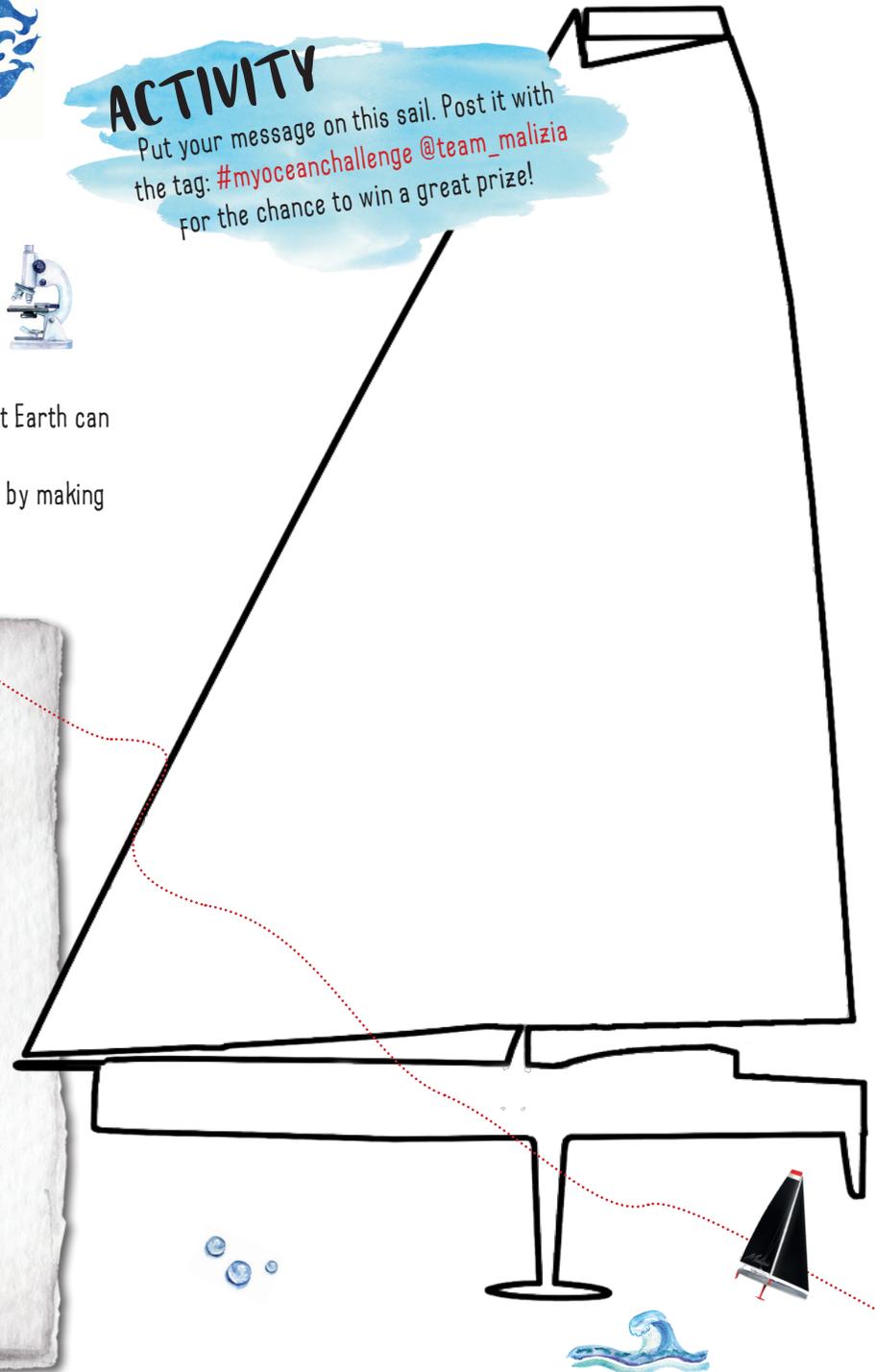
### ACTIVITY

Put your message on this sail. Post it with the tag: [#myoceanchallenge](#) [@team\\_malizia](#) for the chance to win a great prize!

### ACTIVITY

Be ambitious and don't take NO for an answer!  
Identify new solutions!

You can make a big difference! Now and in the future. Maybe you will do research on climate change in the future, pass crucial climate protection laws, or develop new technologies so that people can live in a more environmentally friendly way. **Write your ideas here.**



# What Team Malizia is doing for climate protection...



To generate electricity, there are solar, wind and hydro generators on board. The sailors use solar radiation and wind and water resistance to drive a propeller in the water.

Avoid taking unnecessary flights. For example, planning conferences with technicians using video conferencing.



Understand climate change better and be curious. Help science by providing ocean data.

## ACTIVITY

- Calculate your CO<sub>2</sub> footprint.
- Search the internet for a CO<sub>2</sub> tracker!



Calculate the CO<sub>2</sub> footprint for our team. Give it a go yourself: there are computer programmes online that you can use to estimate how much CO<sub>2</sub> you emit per year.



When in port, transport things by cargo bike instead of by car.

Compensation for the unavoidable CO<sub>2</sub> emissions: we plant mangroves in the Philippines with the help of the Mama Earth organisation. Mangroves are particularly good at absorbing CO<sub>2</sub>. We created the MALIZIA MANGROVE PARK, where over half a million mangroves are being planted.



## WHAT DOES THE COLOURED CIRCLE ON THE SEAEXPLORER SAILS MEAN?

In addition to climate change, there are other major challenges for mankind, such as hunger, poverty, education, etc. To ensure that these important challenges do not fade into the background, all the countries in the world have agreed on 17 goals for sustainable development. The aim of sustainable development is to ensure that the chance of having a good life and a healthy Earth is not spoiled for future generations, i.e. you as children and your children, while at the same time helping the poorest people achieve a better standard of living as quickly as possible.

## RAISE AWARENESS

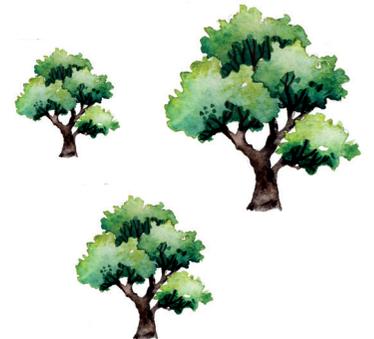
MALIZIA - SEAEXPLORER sails around the world without emitting any CO<sub>2</sub>. It is a symbol for the power of nature. The boat displays a slogan "A RACE WE MUST WIN" in the coloured circle of the UN sustainability goals.



## REFORESTATION

As trees, mangroves, and other plants absorb CO<sub>2</sub> in the atmosphere, reforestation can also help stop climate change.

For every minute that TEAM MALIZIA sails in a race, we plant a tree together with our partners. 21,000 trees were planted during the last race to Brazil.



# What can you do to help *at home* and *at school*?

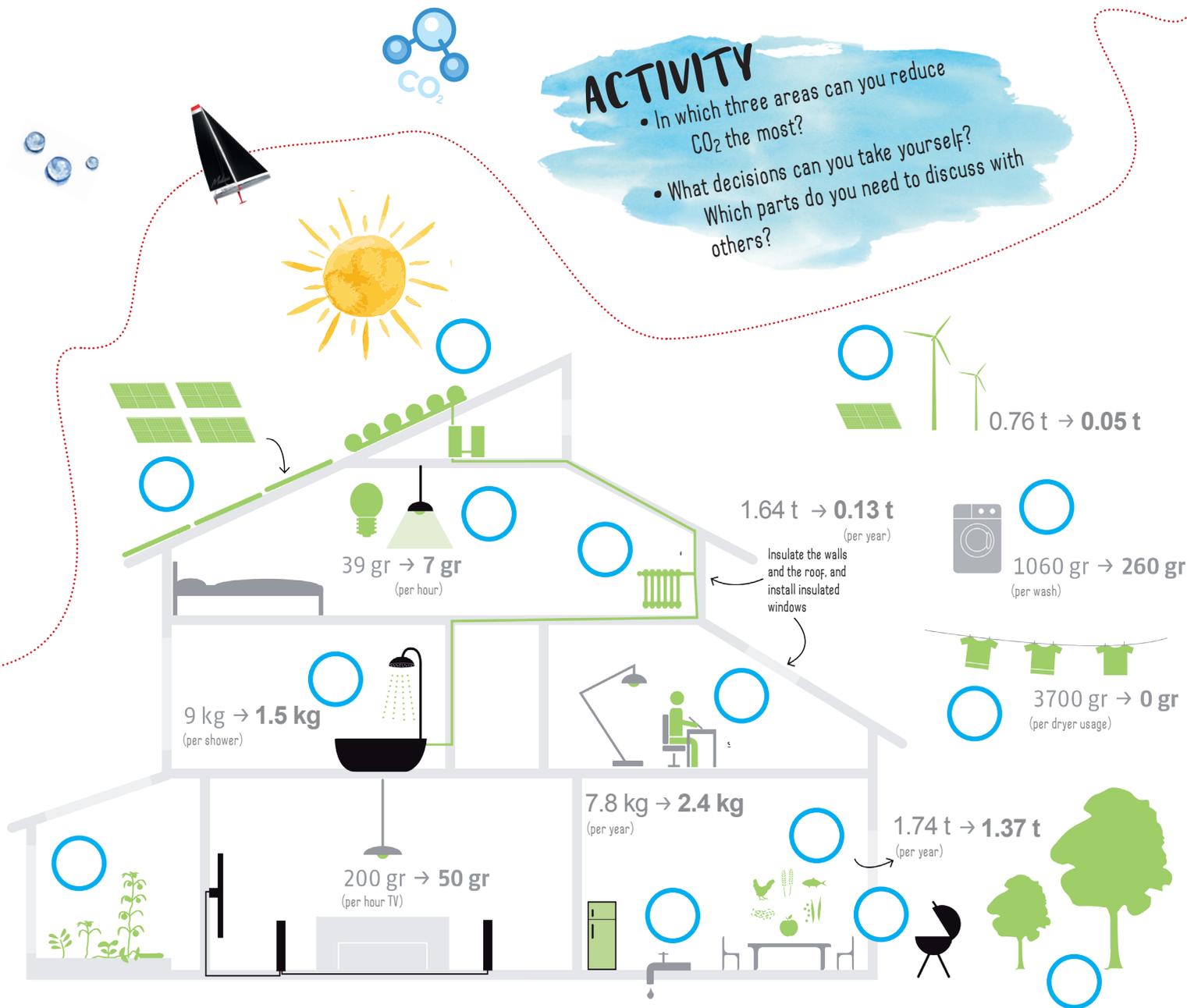
## ACTIVITY

- In which three areas can you reduce CO<sub>2</sub> the most?
- What decisions can you take yourself? Which parts do you need to discuss with others?

## GAME *Match them up!*

Write the number in the right circle

- 1 = Solar heating
- 2 = Solar panel for electricity
- 3 = LED light bulbs; lights off when you leave the room
- 4 = Shorter showers
- 5 = Recycle paper
- 6 = Grow fruits and vegetables in the garden, on the balcony or in the school garden
- 7 = Fridge and freezer at warmer settings
- 8 = Eat less meat and fish
- 9 = Repair devices and buy only those that use less energy
- 10 = Avoid barbecues using coal
- 11 = Ride your bike to school
- 12 = Switch to a green electricity provider
- 13 = Wash laundry using an eco-wash cycle
- 14 = Air-dry laundry instead of tumble drying
- 15 = Plant trees, in the garden or at school
- 16 = Heat and ventilate wisely



# What can you do when shopping?



Check the carbon footprint of your products, in other words how much CO<sub>2</sub> was emitted during the manufacture and transport of the product? This information is increasingly shown on packaging.

Buy local produce



Buy seasonal and organic food when possible



Choose quality over quantity, especially with clothing



These pictures and figures are taken from: THE CLIMATE BOOK by Esther Gonstalla. We highly recommend it.

Before buying something, think about whether you really need the product and if you will actually use it for a long time. Can you repair an old product instead of buying a new one, or borrow from a friend?

## ACTIVITY

*Be proactive!*

1. Use #myoceanchallenge when you post something about this topic!
2. Be creative: make a poster
3. Write an article for your school website
4. Invite a partner class to listen to you present your newly-acquired knowledge
5. Think up a crazy activity to draw attention to this issue: e.g. flash mob, etc. ...
6. Create a sculpture from packaging waste
7. Be a fashion designer. Create a new piece of clothing from old clothes
8. Organise a flea market for your school

## PLAN YOUR ACTIVITY

# Ready to turn about on energy usage?

Many things will change in the future so that less CO<sub>2</sub> is emitted: agriculture, housing, travel, transport, etc. Inventions and technologies can help in many areas, but it is of course also important to change our habits, e.g. turning off the lights when you leave your room or classroom can save energy.

Here we describe ideas for electricity generation, an area of huge consumption across the world. We can, for example, use energy from the sun, wind, ocean currents, waves or the interior of Earth to generate electricity. These energy sources are always available or are easily replenished. They are therefore called RENEWABLE ENERGIES.

## EXPERT KNOWLEDGE

### WHAT IS ENERGY? WHAT DRIVES US?

Everything that people do or that happens needs a "fuel": energy. The energy itself cannot be seen, but its effect can be felt, e.g. through movement, deformation, light and warmth. There is energy stored in electricity, petrol, coal, wind, sun, etc.



### WIND ENERGY

Has been used for millennia to power sailing ships. Boris sails around the world using just the power of the wind. Windmills were also used to grind grain or pump water using the power of the wind. Wind turbines are now used to produce electricity: onshore and offshore. Of course, you also need energy to build such wind turbines, but once in place they will replace that amount of energy in 3 to 6 months. Wind turbines have an effective lifespan of around 20 years.

### ACTIVITY *Build a wind turbine*

You need: cardboard, yoghurt pots, corks, glue, boxes, beads, wire, skewers, plasticine.

- Before you start work, think about what your wind turbine should look like?
- Test your wind turbine outside.



### GEOHERMAL HEAT

Geothermal energy is generated by drilling deep enough into the ground so that the hot water there can be used for heating and power generation. Iceland, for example, meets almost its entire electricity needs by using geothermal energy. It is somewhat easier there because there is a lot of volcanic activity. In Hamburg, the Spiegel building is heated using geothermal energy. However, drilling had to be carried out to a depth of 800 metres to achieve this.



### SOLAR ENERGY

is generated by radiation from the sun, which is felt on Earth in the form of light and heat. Every day, the sun provides many times more energy to Earth than people use during that time. Sunrays can be converted into electricity using solar panels or can heat water on a building roof for heating purposes. Electricity is generated on MALIZIA - SEAEXPLORER using solar panels. Such panels are also installed on some building roofs, traffic lights or in solar power plants, where there is a lot of sunshine, e.g. in Spain.



# Ready to turn about!

## ENERGY FROM THE OCEAN

The Ocean can also provide a lot of energy from the ebb and flow of tides, thermal energy, currents and waves. A clever sea snake uses wave energy to generate electricity at sea off the coast of Scotland. Of course, this is not an actual animal, but a man-made machine that is effectively a wave power plant. The snake is called "Pelamis" (Greek for sea snake) and is about as long as an intercity train. The pipe snake turns wave movements into electricity, which is transferred to land via underwater cables.

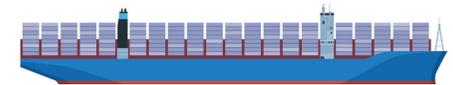


CO<sub>2</sub> absorption from the air



## Power-to-X

Hydrogen is produced using electricity from wind turbines, solar systems, wave power plants, etc. Then CO<sub>2</sub> from the air is used to convert the hydrogen into fuel that can be used in conventional ships and aeroplanes.



## CLIMATE-NEUTRAL FUELS FROM RENEWABLE ENERGIES

You have already learned that renewable energies enable the generation of electricity without emitting CO<sub>2</sub>. However, it can be difficult to replace climate-damaging fuels with electricity in certain cases, such as in shipping and aviation. For example, the batteries required for a large freighter would be much too heavy. But there is a clever process (Power-to-X) through which renewable energies can produce carbon-neutral fuels. This would also allow aeroplanes and ships to be climate-neutral, even when travelling long distances.



# Sea transport and CO<sub>2</sub>

Many things that you use every day have been transported from far away. For example, your trainers probably come from Asia. Trainers are transported in containers.

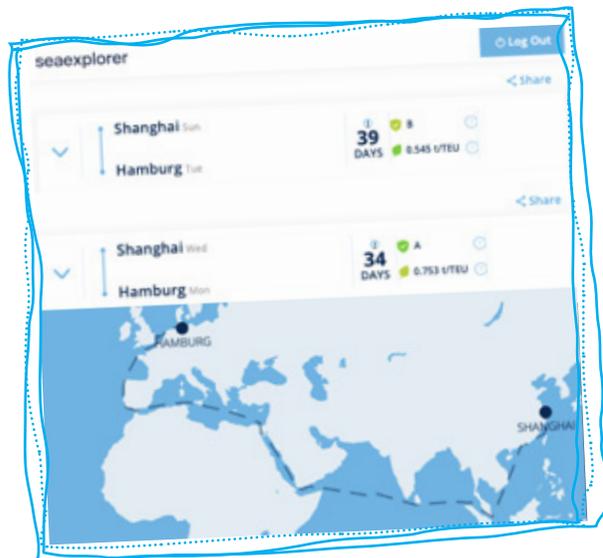
All the container ships together emit approximately 3 per cent of the global CO<sub>2</sub> emissions. There are approximately 45,000 cargo ships in the world.

## SEAEXPLORER.com

There is a special platform that allows company transport managers to ship their goods in accordance with their wishes – it is called SEAEXPLORER. In other words, the same name as our sailing boat. Functions on the seaexplorer platform can be used to select ships with the lowest possible CO<sub>2</sub> emissions.

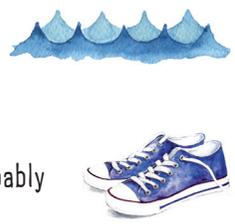
In the example below, you can see how long the voyage takes for two different shipping lines between Shanghai and Hamburg, and how much CO<sub>2</sub> they emit per container for the entire trip.

(one TEU = unit for a small standard container)



## ACTIVITY *Be proactive!*

- Check the labels of your clothes to see where they were made.
- Take a look at where ships are currently en route around the world: [www.marinetraffic.com](http://www.marinetraffic.com)



## EXPERT KNOWLEDGE

### SEA TRANSPORT AND CO<sub>2</sub>

A large cargo ship can carry up to 20,000 containers. Cargo ships take 34-39 days to travel from Shanghai to Hamburg. For this they use about 4,000 tonnes of fuel. Between 500 and 750 kg of CO<sub>2</sub> is emitted per container on this route. Around 100 grams of CO<sub>2</sub> is emitted per pair of shoes.

## EXPERT TASK

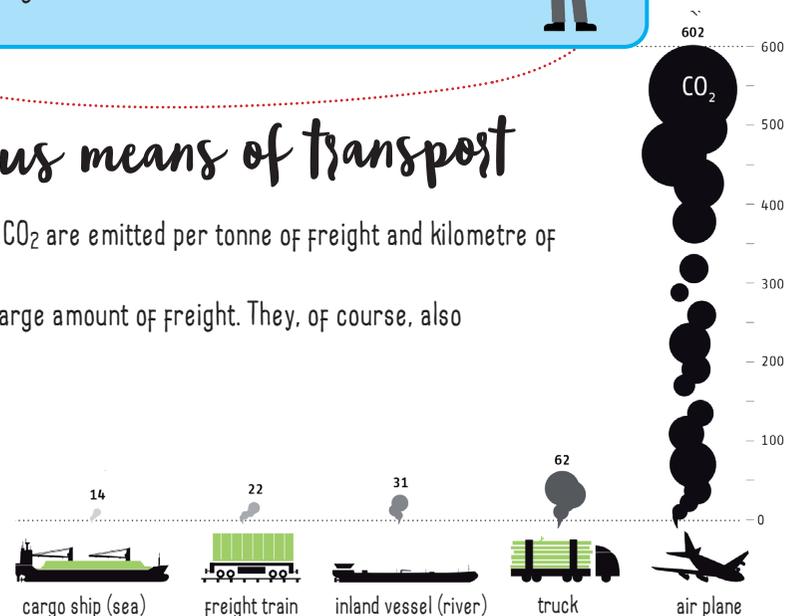
**CALCULATE:** you want to transport a container from Shanghai to Hamburg. The distance is 20,000 km. How much CO<sub>2</sub> would be emitted in total for the journey, if 28 grams of CO<sub>2</sub> is emitted per kilometre? Compare this with the CO<sub>2</sub> emissions resulting from your everyday life on the previous pages.



## A comparison of various means of transport

Transport specialists look at how many grams of CO<sub>2</sub> are emitted per tonne of freight and kilometre of travel to compare various means of transport.

Large freighters at sea can carry a particularly large amount of freight. They, of course, also consume a lot of fuel and emit a lot of CO<sub>2</sub> but compared to trains, smaller barges, lorries or aeroplanes they emit the smallest amount of CO<sub>2</sub> per trailer or per item for the same route.



# Climate-friendly sea transport

## Ship propulsion

Cargo ships used to sail. Then the steam engine was invented. Ships initially had both sails and steam engines. From around 1930 there were hardly any sailing ships left and almost only steam, ships which used coal.

Almost all ships now run on heavy fuel oil. This is an especially cheap fuel and is available almost anywhere.

Unfortunately, burning heavy fuel oil produces a lot of CO<sub>2</sub>. Laws have been passed for 2020 that require heavy fuel oil to be somewhat cleaner, which reduces certain pollutants but not CO<sub>2</sub>.

## Can wind energy be used more in the future?

There are a lot of clever minds designing ships that use the wind in order to emit less CO<sub>2</sub>. Five different designs are shown on the right. These ships really exist, or are under construction. To ensure that these ships do not stop when there is no wind and deliver their goods on time, they also all have an engine. They use a mixture of wind and engine power as propulsion: if there is a lot of wind they can save most of the engine power, whereas if there is not much wind they have to use more engine power. At the end of a voyage, these ships with sails have emitted only half the usual CO<sub>2</sub>. The other half could be saved by using climate-friendly Power-to-X fuel (see page 41).

## ACTIVITY *Ships of the future*

- Describe what you see
- Explain in your own words what is powering these ships
- Match the numbers to the right ship



- 1 = Green container ship with DynaRig
- 2 = Three-masted cruise ship from MSC
- 3 = Cargo ship with towing kite
- 4 = Greenpeace research vessel
- 5 = Car transporter with wing sail



# My carbon-neutral ship of the future



## ACTIVITY *Design a ship!*

- Imagine that you want to transport goods across the world's Ocean or travel yourself, whilst emitting as little CO<sub>2</sub> as possible. What would your ship look like?
- Maybe you have some ideas to help make MALIZIA - SEAEXPLORER become the fastest boat in the world?
- Please send us a photo of this page, with your design, to [myoceanchallenge@borisherrmannracing.com](mailto:myoceanchallenge@borisherrmannracing.com), or create a post with the photo using the hashtag [#myoceanchallenge](https://twitter.com/myoceanchallenge)
- Seeing your creative ideas for climate protection really motivates Boris and Pierre!
- Win great prizes from TEAM MALIZIA!



## My ideas

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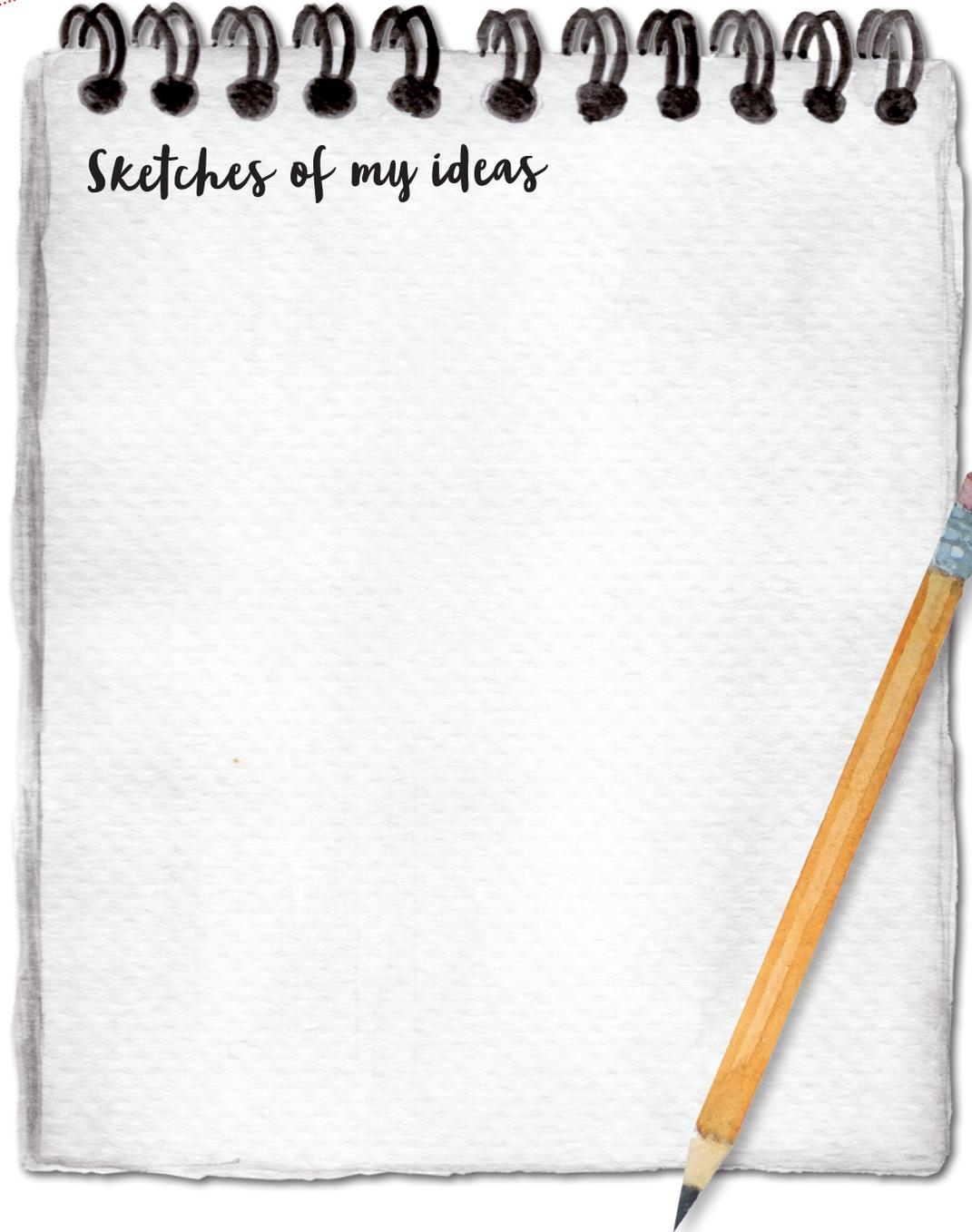
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## Sketches of my ideas



# My design



# Thanks for taking part!



I found these things especially interesting...

Handwriting practice lines consisting of a solid blue top line, a dashed blue middle line, and a solid blue bottom line. There are ten such lines for writing.



The following could be improved...

Handwriting practice lines consisting of a solid blue top line, a dashed blue middle line, and a solid blue bottom line. There are seven such lines for writing.

I didn't understand these things...

Handwriting practice lines consisting of a solid blue top line, a dashed blue middle line, and a solid blue bottom line. There are five such lines for writing.

# We look forward to receiving your feedback!



WE WOULD BE VERY GRATEFUL IF YOU COULD SEND US PHOTOS OF PAGES 46 AND 47.  
Please send the photos to: [myoceanchallenge@borisherrmannracing.com](mailto:myoceanchallenge@borisherrmannracing.com)



## My questions for TEAM MALIZIA ...

Handwriting practice lines for questions.

## 💡 My new ideas & plans concerning climate change...

Handwriting practice lines for ideas and plans.



"... The young generation has the potential to change the fate of the world. Don't underestimate that!"

(Prof. Dr. James Hansen, former Director of NASA, Columbia University Earth Institute)<sup>1</sup>



[myoceanchallenge.org](http://myoceanchallenge.org)

Special thanks to our patient art director, Jens Böckmann, our scientific friends and the "Friends of MALIZIA".

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<sup>1</sup>Excerpt taken from: The Climate Book, by Esther Gonstalla, published by oekom Verlag



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