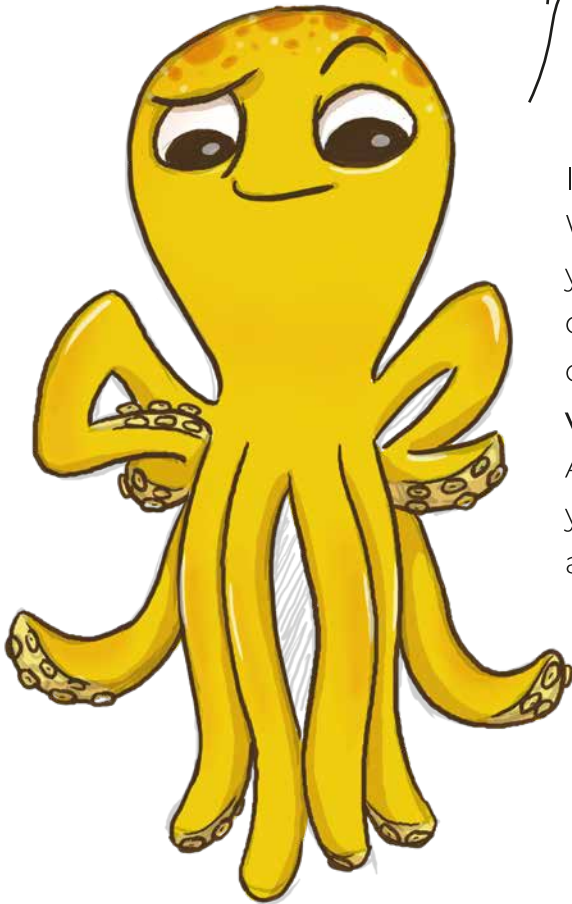




With **Okto** the octopus
& **Marjo** the researcher

Cycle 3 - 2024

Hi there ! My name's Okto



I'm a **deep-sea explorer**.

With **Marjo** the researcher, I'd like to invite you on an extraordinary journey through the deep ocean. Together, we will explore the ocean depths, particularly the **hydrothermal vents** !

And, most important of all, I will explain how you can help scientists by becoming a deep-sea spy yourself...

IDENTITY INFORMATION

Name : Okto
Group : Mollusca
Class : Cephalopoda
Order : Octopoda
Family : Octopodoidae

Distinguishing characteristics : 8 tentacles, 2 large eyes, a well-developed brain

Mission : Deep Sea Spy
Objectives : To introduce you to the mysteries of the deep ocean so that you can become a deep-sea spy

DEEP SEA EXPLORATION

Where to go to play ?

<https://ocean-spy.ifremer.fr/deep-sea-spy/>



Type the URL address

<https://ocean-spy.ifremer.fr/deep-sea-spy/>

in the navigation bar

or scan the QR code with your tablet



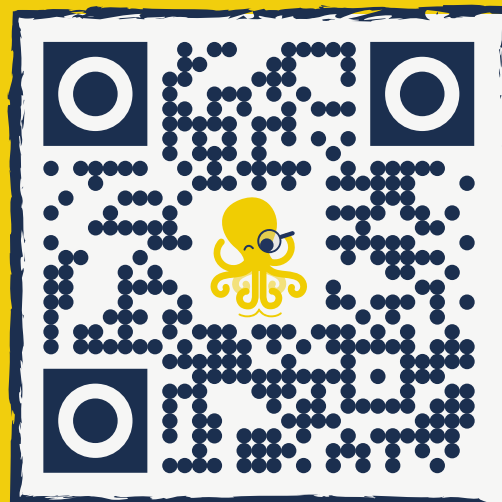
Connect with your username
and your teacher's password



Help Marjo to find
and identify the animals



Move up the levels
and win virtual figurines



Ocean Spy

<https://ocean-spy.ifremer.fr/>

The **Deep Sea Spy** project is part of the **Ocean Spy** family. With the same username and password, you'll be able to choose other ecosystems and contribute to advance science!



Find some of the answers at
www.deepseaspy.com

DEEP SEA TOPOGRAPHY

The deep ocean

Oceans cover $\frac{3}{4}$ of the earth's surface, with an average depth of 4000 metres. The deep ocean accounts for 60% of this area.

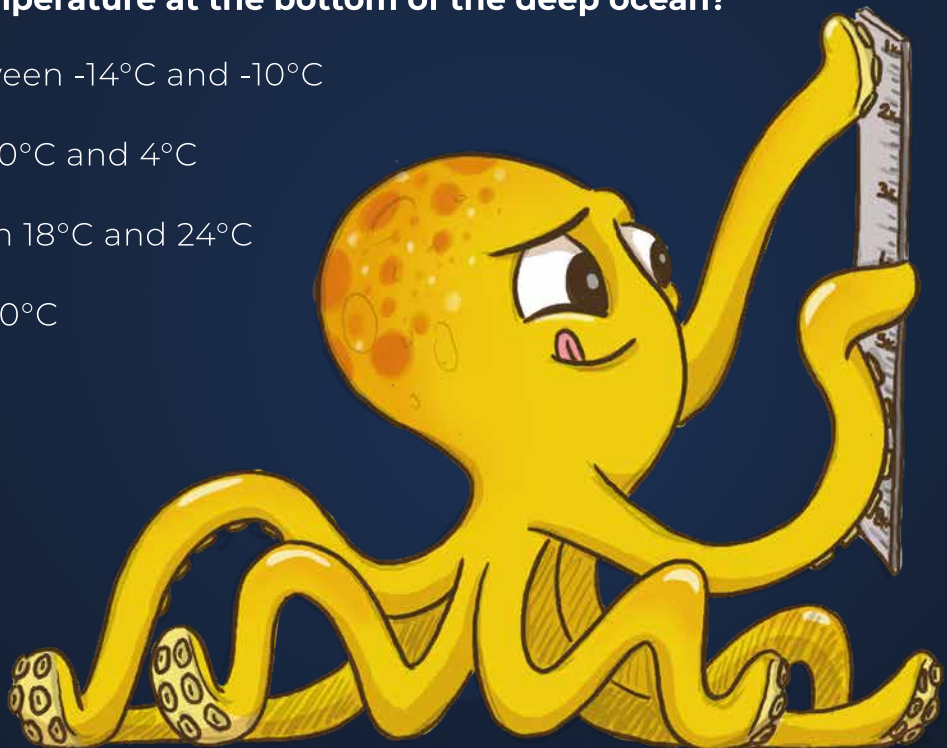
What is the maximum depth of the ocean?

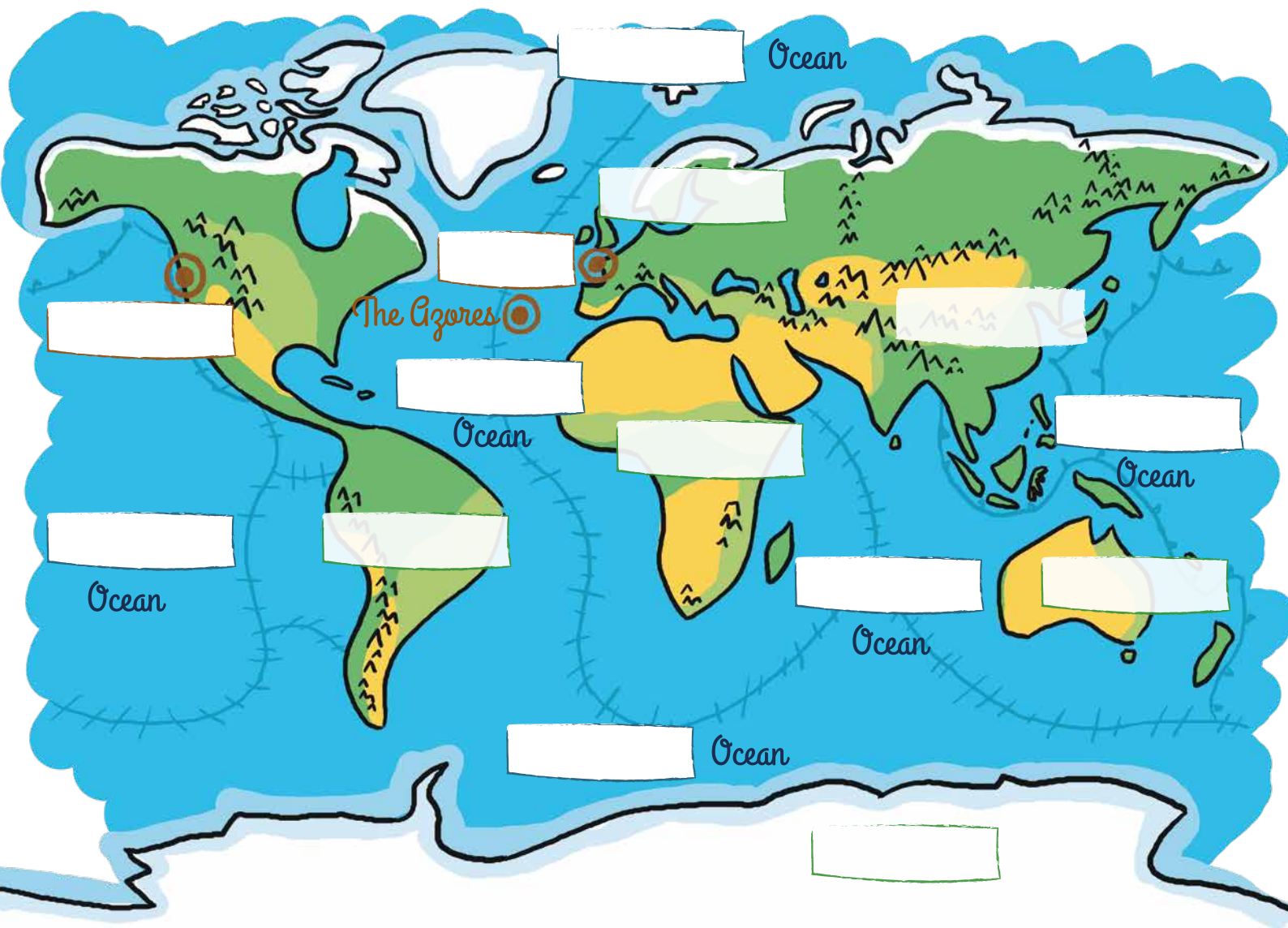
- ☐ 90 meters
- ☐ 900 meters
- ☐ 10 900 meters

Surface water temperature varies a great deal across the planet. Tropical waters are 25°C while polar waters are about 0°C. At the bottom of the ocean, temperatures do not change very much.

What is the water temperature at the bottom of the deep ocean?

- ☐ Very cold, between -14°C and -10°C
- ☐ Cold, between 0°C and 4°C
- ☐ Warm, between 18°C and 24°C
- ☐ Boiling, over 100°C





Fill in the blanks with the names:

- of the different oceans : Antarctic, Arctic, Atlantic, Indian, Pacific
- of the different continents : **Antarctica**, Africa, America, Asia, Australasia, Europe
- and of the cities **Brest** and **Vancouver**

Finish the legend:

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Additional information :

The distance between Brest and Vancouver is 7700 km.

Did you know ?

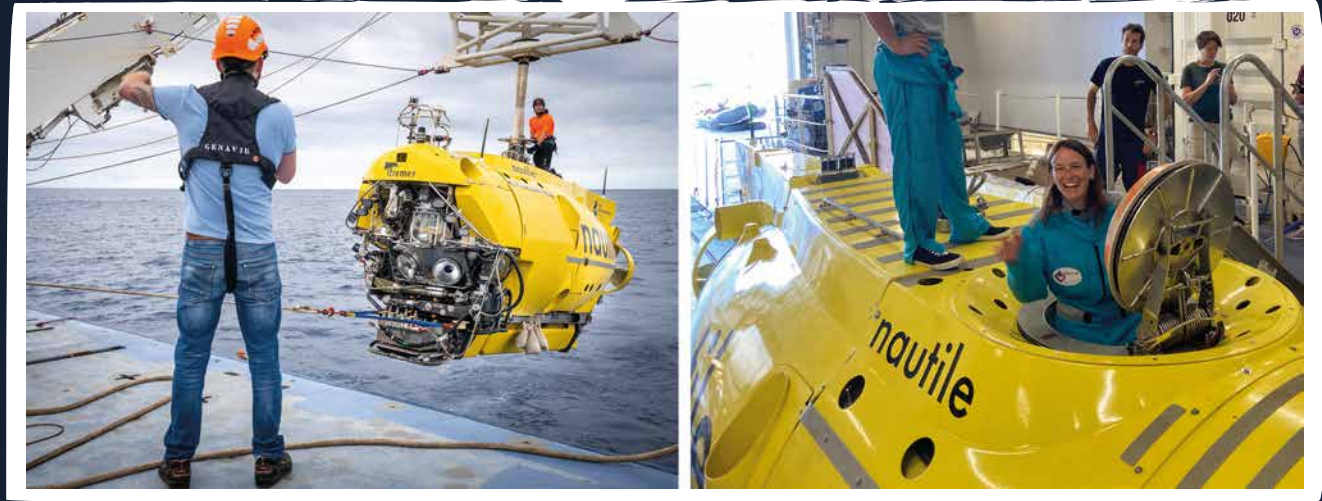
In the deep ocean
 It's dark
 It's cold
 It's "deep"
 It's "hungry"

Théodore Monod



AN OCEANOGRAPHIC CRUISE

During a cruise, a yellow submarine explores and discovers animals that live at the bottom of the oceans. During a dive, the team onboard the submarine spends **eight hours in a small sphere** made of titanium (a metal) with a pilot and co-pilot onboard.



Submersibles are lowered in the water from a ship.



AN OCEANOGRAPHIC CRUISE

At sea, the **chief scientist** works with the captain to organise the cruise. The crew is composed of many jobs. The **officers** are responsible for navigation, the **deckhands** maintain the ship and deploy the scientific equipment, the **mechanics** look after the engines and the **kitchen crew** cook for everyone. The **submarine team** ensures the good functioning and piloting of the submarine for scientific work.

Match each job with its photo.

☐ Cook

☐ Diver

☐ Captain

☐ Scientist

☐ Mechanic

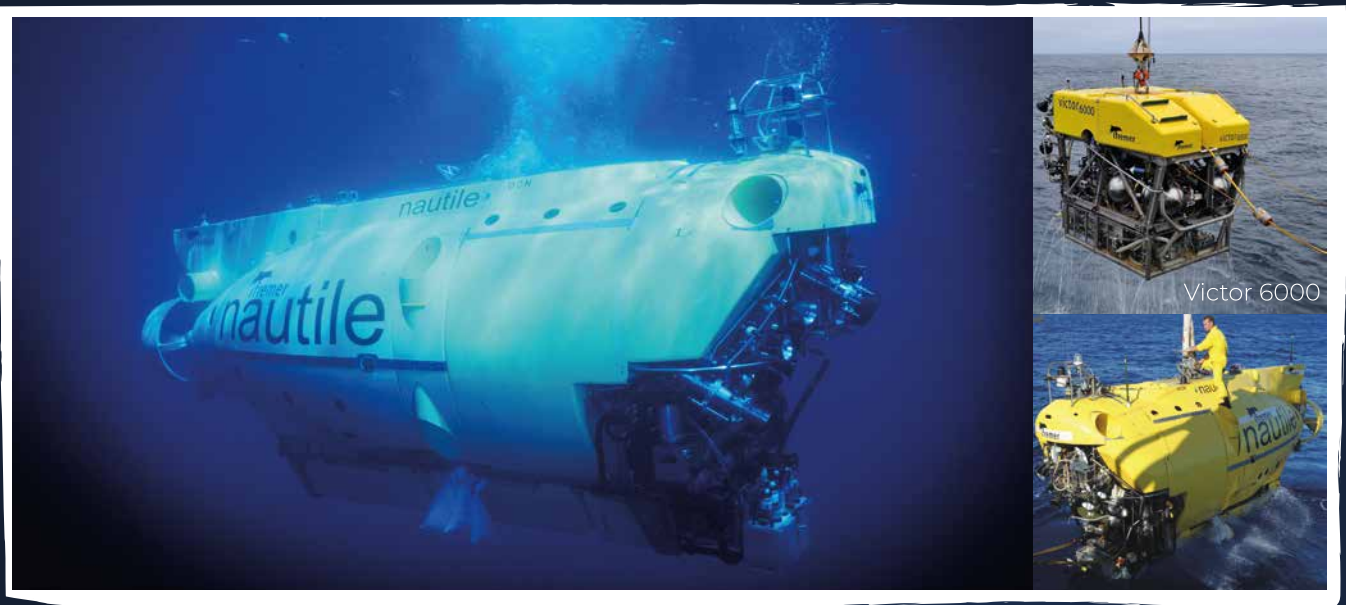
☐ Deckhands



SCIENTIFIC EXPLORATION OF THE DEEP OCEAN

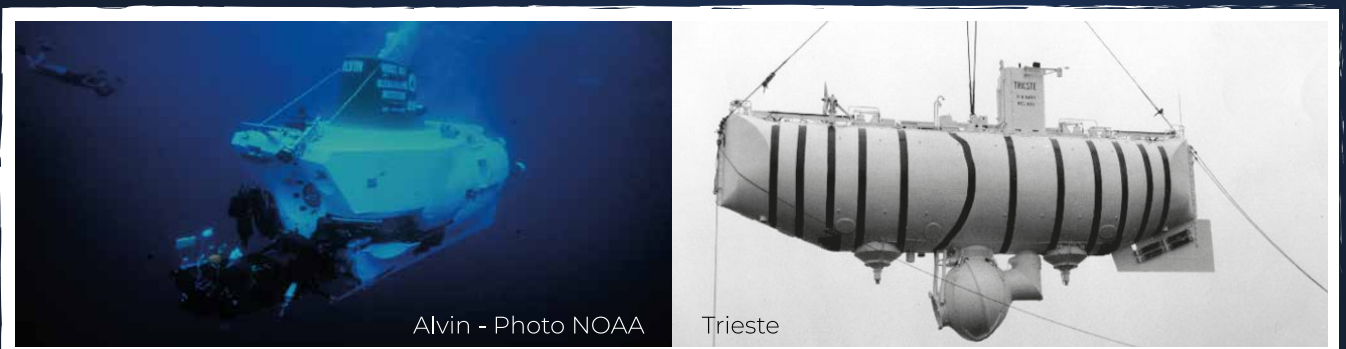
Scientists have always tried to understand how the deep ocean functions. They have many different submarines capable of going down very deep in the ocean. **Equipped with cameras and articulated arms**, these vehicles make it possible to study and collect the fascinating animals of the deep ocean.

Look at these exploration "vehicles".



What is the name of this submarine attached to a cable, put into service by Ifremer in 1998 and capable of exploring depths of up to 6000 metres?

The

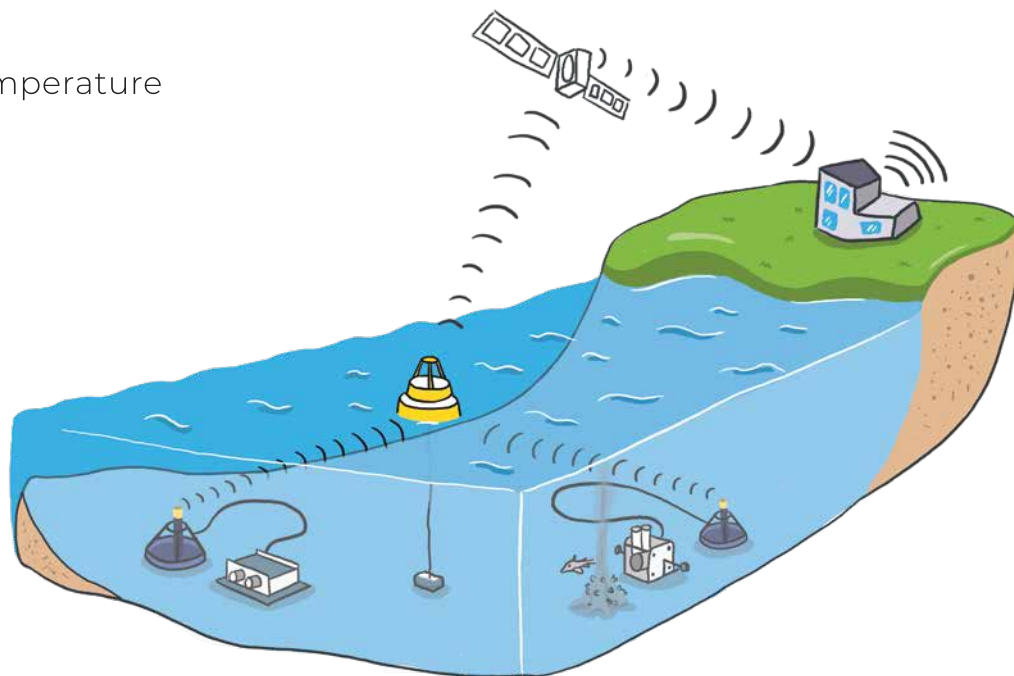


SCIENTIFIC EXPLORATION OF THE DEEP OCEAN

The submarine observatories are equipped with instruments that remain on the bottom for years.

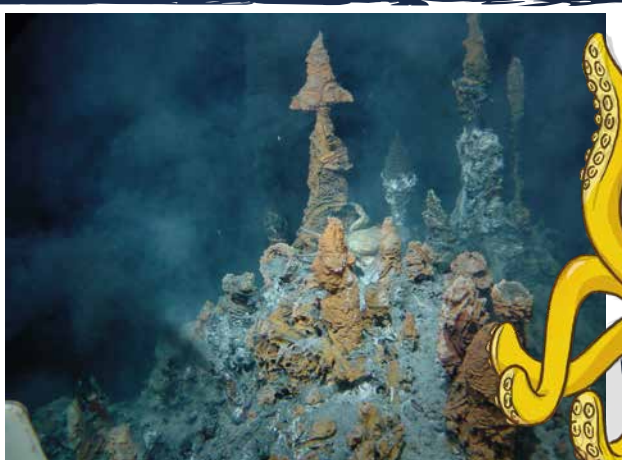
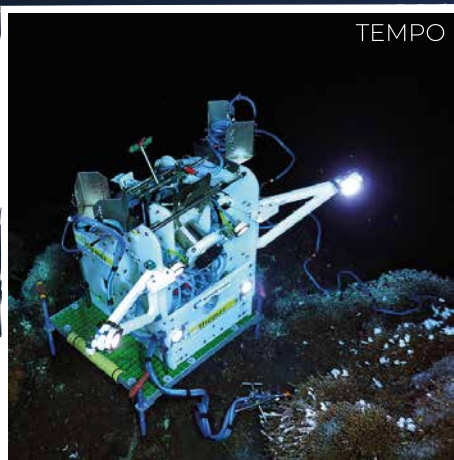
What do the instruments on the submarine observatories measure? Tick the right boxes.

- ☐ Seawater temperature
- ☐ Currents
- ☐ Pressure
- ☐ Light



Did you know ?

The TEMPO ecological module, conceived by teams at Ifremer, is equipped with a camera with four spotlights on arms, a temperature probe, an oxygen probe and a chemical analyser.



THE GAME

<https://ocean-spy.ifremer.fr/deep-sea-spy/>

Marjo is a scientist who studies animals that live in the deep sea. **Her playground is the oceans, everything that's blue on the map !**

Marjo's studies enable her to understand who these animals are, where they live, and what they do. It's very important to understand this because each species plays a crucial role on the planet. Knowing them **better means better protection for them**, and thus protecting our home : Earth.

Come and help me observe them !

**MARJOLAINE MATABOS
RESEARCHER IN ECOLOGY
OF DEEP SEA ENVIRONMENTS**

IDENTITY INFORMATION

Community : Scientific

Institute : Ifremer

Sub-group : Deep Sea Lab

Mission : Understanding the biodiversity of the deep sea

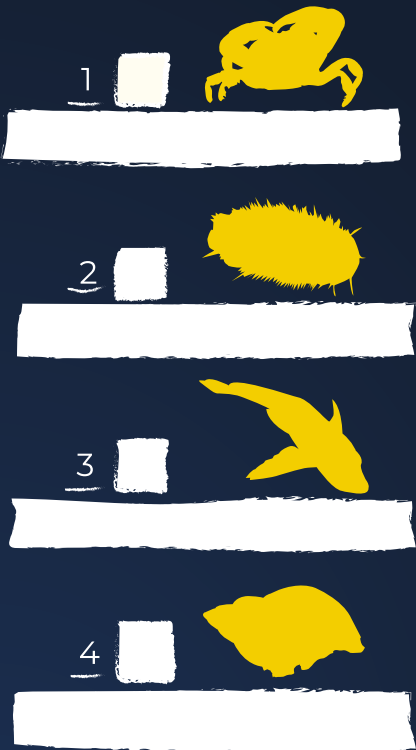
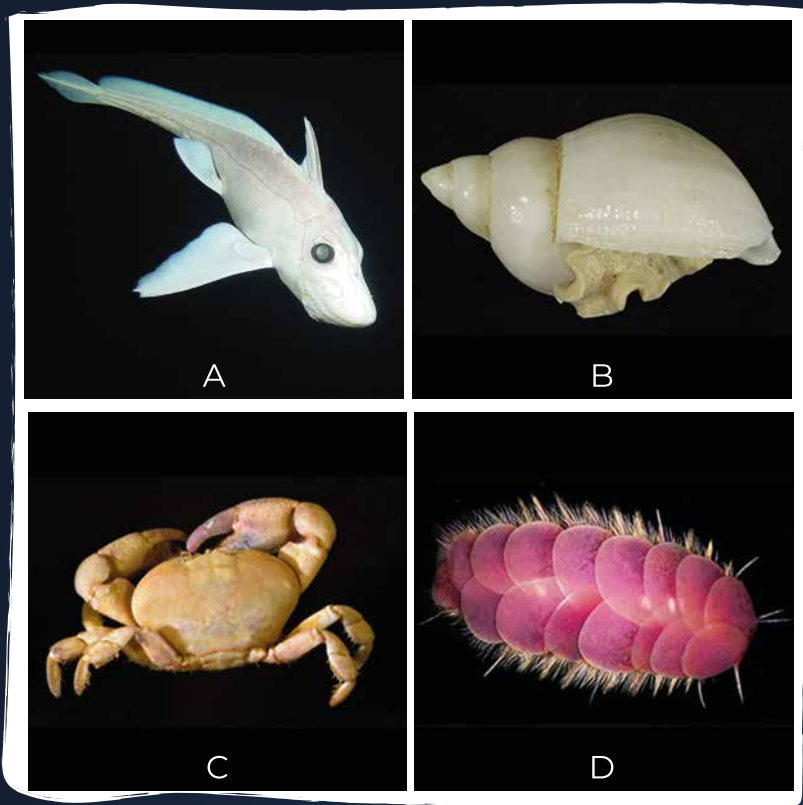


THE GAME

<https://www.deepseaspy.com/>

Help our scientist, Marjo, to identify these species.
Match each species with its silhouette.

Fill in the corresponding letter and name.



Tick the boxes that correspond to the attributes of the Buccinid snail or Chimera fish.

	Buccinid snail	Chimera fish
2 Pairs of antennae		
Flat foot		
Eyes and mouth		
Internal bony skeleton		

The chimera fish is

The buccinid snail is

HYDROTHERMAL VENTS

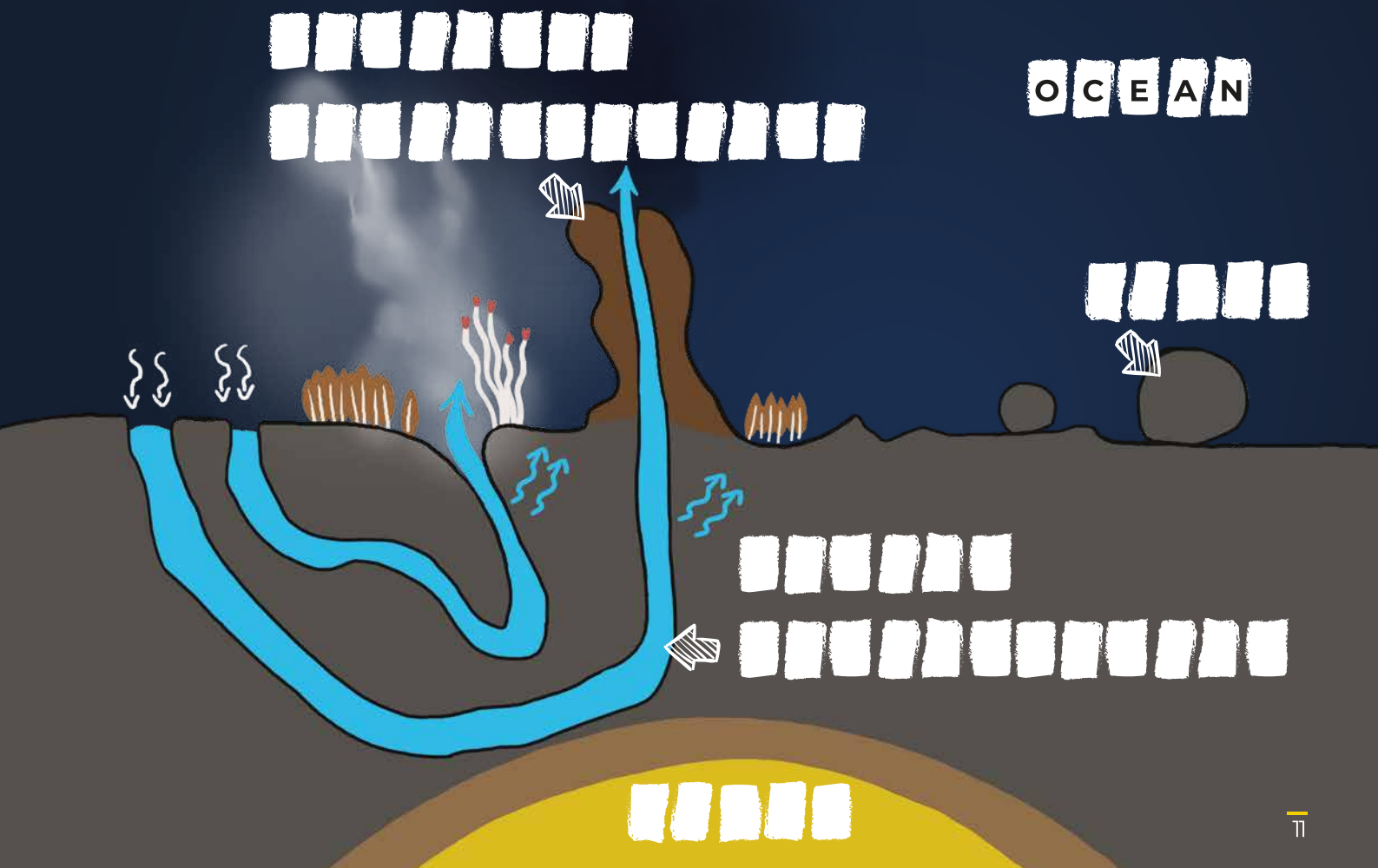
Oases at the bottom of the ocean

Hydrothermal vents were discovered in 1977. They are real submarine geysers located along the ocean ridges. This discovery revealed the existence of rich animal communities in the deep ocean.

Along the submarine mountains, seawater penetrates into the ground, then goes down towards the magma chamber. On this journey, the water heats and is transformed. The hydrothermal fluid made this way rises to the surface to form "black smokers". The fluid ejected can reach **temperatures of 400 °C**.

**Put the right names on the parts of the cross section
of the hydrothermal vent :**

Magma / Ocean / Black smoker chimney / Rock / Hydrothermal fluid

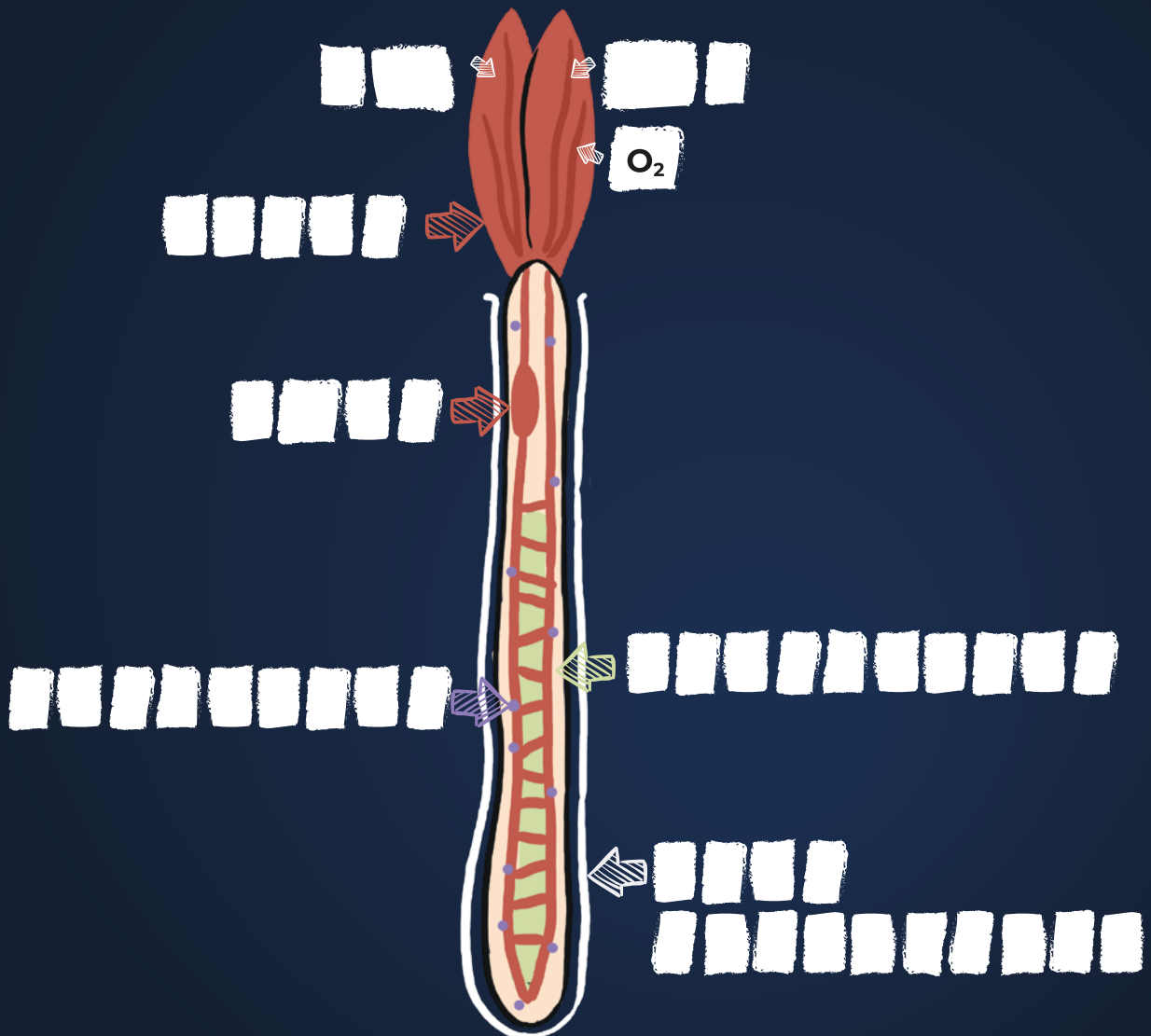


REMARKABLE ADAPTATIONS

Symbiosis

Hydrothermal vents harbour a dense and fragile fauna. The tubeworm *Ridgeia piscesae* is a perfect illustration. This brightly-coloured "feather duster" lives in symbiosis with bacteria that develop in a "sack" called the trophosome. These produce their food.

Put the right names on the cross section of the tubeworm :
Heart / Trophosome / Protective tube / Bacteria / CO₂ / H₂S / O₂ / Plume



A FEW STORIES TO KNOW ABOUT ANIMALS

This octopus, also known as Dumbo, is called *Grimpoteuthis*. This abyssal octopus lives in all oceans **between 500 and 4000 m deep**. Encounters are rare but always magical !



The chimera *Hydrolagus affini* evolves at depths ranging **from 300 to 2400 meters**. It is highly prevalent around the ridge where it feeds on hydrothermal mussels *Bathymodiolus azoricus*. Shells have been found in their stomach !



REMARKABLE ADAPTATIONS

Animals of hydrothermal vents have special characteristics for resisting environmental variations such as temperature (2°C to 50°C), or concentrations of mineral elements or oxygen.



The limpet *Lepetodrilus fucensis* feeds on bacterial films, which grow on the shells of the tube worms' tubes. It has a radula equipped with tiny teeth.

What is the limpet's diet?

The crab *Segonzacia mesatlantica* is an opportunist because it lives on carrion and easy prey (mussels, shrimps and polychaete worms). It is a solitary and territorial animal.

What is the crab's diet?



THE MINERAL RESOURCES

As it passes through the Earth's crust – made of rocks, the hydrothermal fluid is charged with metals that are then found in the rock of the chimneys. The edifices thus formed are composed of minerals rich in metals. A mineral is a non-living material formed naturally by the planet.



Metals are used in the construction of everyday objects.

Iron is the most widely used metal. It is transformed into steel for buildings. It is also used in medicines.

Copper is used in the manufacture of cables, wires and electrical circuits, as it is a very good conductor, as well as in piping and plumbing.

Zinc and cobalt are used in the automobile industry, roofing, household appliances and industrial equipment.

Gold is used to make coins and jewellery.

Rare earths are used in the manufacture of screens, the digital industry and renewable energy (solar panels, wind turbines) because of their magnetic properties

THE MINERAL RESOURCES

Match each metal with the object it is used for.

☐ Iron

☐ Copper

☐ Aluminium

☐ Rare earth

☐ Zinc



Did you know ?



Seabed mining will use machines that will destroy ecosystems, and therefore the animals and their homes. Scientists do not yet have enough information to predict the impact of this new human activity. Exploitation has not yet begun but many countries are interested in these resources, at the risk of damaging the deep ocean.

A RICH ECOSYSTEM

The animals live in different places around the hydrothermal vents depending on the temperature and food availability.

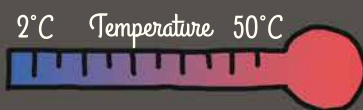
Place the following animals on the hydrothermal vent.

1. Clumps of tube worms *Ridgeia piscesae*
2. Limpet *Lepetodrilus fucensis*
3. Mussel *Bathymodiolus azoricus*
4. Spider crab
5. Crab *Segonzacia mesatlantica*
6. Chimera fish *Hydrolagus*

Pacific Ocean

Atlantic Ocean

Bacteria



GLOSSARY

TECTONIC PLATES

The earth's crust (on land this is the ground and under water it is the ocean floor) is divided into several plates that "float" on the surface of our planet. Under these plates, we find molten rock or magma, a viscous substance constantly in motion. This motion causes the plates (called tectonic plates) to collide (which is what forms the mountains), to separate, allowing the magma to rise up between them (ocean ridges), or to overlap (subduction zones).

MAGMA

Magma is molten rock. It's pressure and high temperature that cause the Earth's crust and mantle to melt. When the pressure becomes too great, the magma breaks through the Earth's crust to form volcanoes.

ECOSYSTEM

A network made of the physical environment - called the biotope - and all the animals that live there - the biocenosis. The ecosystem also includes all the interactions between the organisms themselves and with their environment.

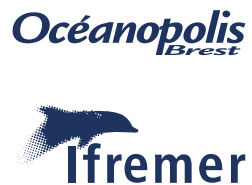
SMOKERS

When the hydrothermal fluid emerges from the earth's crust forming large underwater geysers, the metals in the water precipitate when they come in contact with the cold water. They then become solid, forming great chimney-like structures known as smokers.

- SOME FIGURES ON THE DEEP SEA ENVIRONMENT -

The ocean covers nearly three quarters of our planet.

The deep ocean environment includes all of the marine environment below 200m, where the light can no longer reach. Three quarters of the ocean are "deep". The deep ocean contains 95% of the inhabitable volume of the planet.



www.deepseaspy.com