

# Thematic itineraries

This document is dedicated to school teachers who would like to use different teaching aids (panels, videos, aquariums, exhibits) present in the "Pavillon des Expositions Permanentes" (PEP) of "La Cité de la Mer", to illustrate a course about movements and strengths.

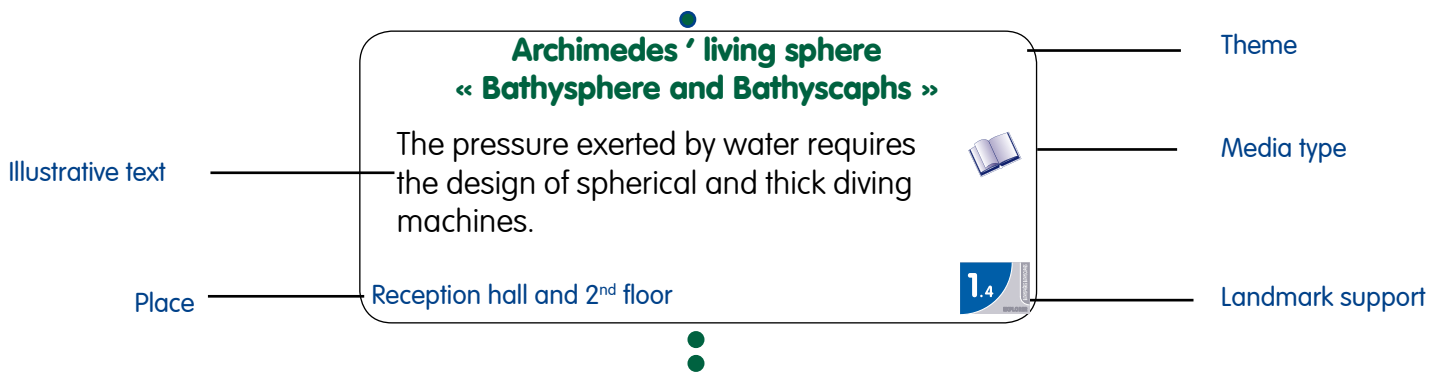
Three main themes are considered:

- > The pressure exerted by water
- > Archimedes' pressure
- > Movements (strengths and speed)

The different areas of the exhibition are numbered: the following itinerary shows the main teaching aids of the exhibition concerning these 3 themes and also their landmarks.

Some help and advice to prepare the visit could be obtained for free, by contacting the teachers working for the educational service of "La Cité de la Mer".

## How can this itinerary be used?



### CAPTIONS:

- Aquariums (B1 à B17)
- Panels
- Interactive screens
- Videos
- Scale models
- Show cases



## THE PRESSURE EXERTED BY WATER - 1

### DIVING EQUIPMENT

#### Living sphere of Archimedes « Bathysphere and bathyscaphs »

The pressure exerted by water requires the design of spherical and thick diving machines.

↳ Reception hall and 2<sup>nd</sup> floor



#### The pioneers: diving bell, diving suit, regulator

If they want to breathe, divers need some air under pressure to fight against the forces exerted by water pressure on the ribcage.

↳ Exhibitions access (1<sup>st</sup> floor)



#### « The Lethbridge barrel » « From the bell... to the scaphander »

The pressure exerted by water compresses the air in the diving bell and also in the barrel.

↳ Exhibitions access (1<sup>st</sup> floor) and 2<sup>nd</sup> floor



#### « The conquest of the deeps »

Structure of bathyspheres, diving suits.

↳ 2<sup>nd</sup> floor



#### Pressure and breathing

The pressure exerted by water prevents breathing. The sphere is the best possible shape for resisting water pressure.

↳ 2<sup>nd</sup> floor



## THE PRESSURE EXERTED BY WATER - 2

### WATER PRESSURE

#### The thickness of aquarium' glass

Methacrylate glass thickness of the Abyssal aquarium needed to resist the pressure of the water



↳ 2<sup>nd</sup> floor



#### Living under pressure

The parts of the body which are sensitive to pressure



↳ 2<sup>nd</sup> floor



#### « Oases » and « Back to sources »

Water pressure is very important in abyssal hydrothermal sources.



↳ 1<sup>st</sup> floor



#### Pressure at a 10 metres depth

Quizz



↳ 1<sup>st</sup> floor



#### Ultra deep petrol

Water pressure levels on the pipelines are much greater in the ultra deep



↳ 1<sup>st</sup> floor



#### Strength and pressure

Strength exerted by the pressure of water



↳ Downstairs



### SUBMARINE HULL

#### « Yellow submarines »

Pressure exerted on the hull of bathyscaphs and spherical shape of the hull



↳ Reception hall

#### Structure of the hull

The structure of the hull is adapted to pressure.

↳ Le Redoutable

#### Teamworks / structures

The submarine' hull is rigidified thanks to structures called "teamworks".



↳ Downstairs



#### Deep in the ocean

Resistance of different shapes to water pressure: spheres, egg-shaped, water drop shape "albacore" of the submarines



↳ Downstairs



#### The story of shapes

The shape of the submarine hull allows a resistance to the pressure exerted by water.



↳ Downstairs



#### Steel

Thick steel with exceptional characteristics constitutes the submarines hull.



↳ Downstairs



## ARCHIMEDES' PRINCIPLE

### « Yellow submarines »

Bathyscaphs leave some ballast to ascend.

↳ Reception hall



### The bathyscaphe Archimedes

To ascend, descend or to keep its balance, the bathyscaphe adjusts its weight (ballast) relative to the Archimedes' pressure which is exerted.

↳ Reception hall



### Ballast needed for the bell's immersion

From bell... to diving suit

Some ballast is sometimes needed to fight the Archimedes' pressure : balls, bells, shoes of hard-helmet diving equipment, today lead belt of the divers...

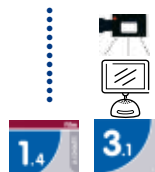
↳ Exhibitions access (1<sup>st</sup> floor) and 2<sup>nd</sup> floor



### « The conquest of the deeps »

If they want to descend, divers have to be ballasted to fight Archimedes' pressure. Diving equipments: hard-helmet diving equipment, lead belts...

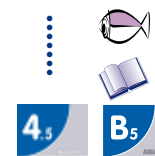
↳ 2<sup>nd</sup> floor



### Ballasts, floats and parachutes

The nautilus uses ballasts to ascend and descend.

↳ 2<sup>nd</sup> floor



### The Archimedes' pressure

For an object to sink, its weight has to be higher than the Archimedes' pressure.

↳ Downstairs



### Ballast tanks

To dive, a submarine fills its ballast tanks. Forward and aft tanks of a SSBN.

↳ Downstairs



### Ballasting principle

Interactive screen « Piloting » and piloting simulator « Le furtif »

↳ Downstairs



## MOVEMENTS

### STRENGTHS AND MOVEMENTS

#### The bathyscaphe Archimedes

Three propellers are needed to stabilize the bathyscaphe Archimedes in the three directions.



↳ Reception hall

#### Locomotion of marine animals

Marine animals use different techniques to move in the water.



↳ 2<sup>nd</sup> floor



#### « Undersea cables »

Undersea cables have to resist the current forces.



↳ 1<sup>st</sup> floor



#### Propellers

The submarines use propellers for their propulsion.



↳ Downstairs



#### Steel

Flexible and resistant steel is used to build the submarines' hull



↳ Downstairs



#### Le Redoutable

It is the force exerted by steam on the turbines which allows the rotation of the submarine propellers.



↳ Le Redoutable

### SPEED AND MOVEMENT

#### « Measuring currents »

The currents speed can be measured with different methods, for example using the Doppler effect.



↳ 1<sup>st</sup> floor



#### Speed of submarines

The speed of a submarine has to be considered in navigation calculations. It can reach more than 20 knots. Interactive screen « Navigation »



↳ Le Redoutable and Downstairs

