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Dive! Dive! Dive!
下潜 下潜 下潜
【浮力】
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Contents 目录

有些单词被印刷成粗体，**就像这样。**你可以在第30页中找到它们的意思，还可以在单词第一次出现时，在相关书页下方的方框内发现它们的含义。

Hidden danger
暗藏的危险

A submarine floats on the ocean. The lookout sailor searches all around. He spots smoke in the distance. An enemy battleship is moving towards them. The only escape is to go under water. The captain shouts the order, "Dive! Dive! Dive! "

Submarines are special boats. They can travel under water. Some submarines are used to explore the oceans. They look for shipwrecks. They look for amazing sea animals.

Most submarines belong to navies. In war time, submarines spy on enemy ships. They might try to sink the ships with guns. They also use **torpedoes**. Torpedoes are weapons. They can be fired under water.

Submarines can float on the surface of the ocean. But they can also do something that other boats cannot. They can hide deep under the water.

一艘潜艇行驶在海面上，哨兵向四周侦察着。他发现远处冒出轻烟。一艘敌人的战舰正向他们驶来。要躲避战舰就只能藏到水下，艇长大声命令："下潜！下潜！下潜！"

潜艇是一种特殊的船。它们能在水下航行。有些潜艇用来探测海洋，搜寻失事的船只，寻找奇异的海洋生物。

大多数潜艇属于海军部队。战争期间，潜艇用来侦察敌船。它们可以用炮来击沉敌船，也可以使用**鱼雷**。鱼雷是一种可以在水下发射的武器。

潜艇可以浮在海面上。但它们深藏水下的本领却是其他船只无法比拟的。

torpedo (鱼雷)

▼ Submarines let a crew of sailors hide under water.

潜艇上的海员可以隐藏在水下。

Floating and diving
沉浮之间

Some submarines weigh as much as 2500 elephants! It might seem strange that they can float. But they can float because of **forces**.

Forces are pushes or pulls. They can make objects move. They can make objects change shape.

Gravity is a force. It pulls everything towards the centre of Earth. The pull of gravity gives an object its weight.

有些潜艇的重量相当于2500头大象！它们能浮起来可能很奇怪。但是靠**力**的作用，它们的确能浮起来。

力就是推动或者牵引的作用。它能使物体运动或改变物体的形状。

重力是一种力。它把所有的物体拉向地心。物体有重量是由于受到重力的作用。

force (力) gravity (重力)

Gravity makes things fall to the ground when you drop them. Gravity can also pull objects down through water. That is why a stone sinks when you drop it into a pond. But some objects do not sink.

When something is in water, it pushes some of the water out of its way. The water pushes back! Try pushing a beach ball under water. You can feel the water pushing back.

重力可以使抛出的物体落向地面。重力也可以使水中的物体下沉。这就是扔到水池里的石头会下沉的原因。但是有些物体不下沉。

水中的物体会排开一些水。而这些水又会反过来推它！把一个海洋球向下推，就能感觉到水的反推作用。

▼ Gravity pulls the submarine downwards. The water pushes it upwards.

重力向下拉潜艇，水则将它向上推。

How hard does the water push back?
水的推力有多大？

Water has a pushing **force**. It pushes up on everything in it. This is called a **buoyant force**. It pushes a submarine upwards.

Weight is the force caused by **gravity**. Weight pulls the submarine downwards.

- The submarine will rise if the buoyant force is greater than its weight.
- The submarine will float if the buoyant force is exactly the same as its weight.
- The submarine will sink if the buoyant force is less than its weight.

The size of the buoyant force is different for every object. It depends on the amount of water that the object pushes out of its way.

水是有推**力**的，它会把水中的所有物体往上推。这种力叫做**浮力**。浮力把潜艇向上推。

重量是由于受到了**重力**，重量使潜艇向下沉。

- 如果浮力大于重量，那么潜艇会向上浮起。
- 如果浮力正好和重量相等，那么潜艇就会浮在水面。
- 如果浮力小于重量，那么潜艇就会下沉。

每个物体受到的浮力大小是不同的，它取决于物体排开水的量。

Super strong
大力士

The **buoyant force** makes it easy to lift a person in a swimming pool. Weight pulls the person downwards. The buoyant force pushes them upwards. It cancels out some of the person's weight.

浮力可以使人在游泳池里被轻松地举起来。重量使人向下沉，浮力把人向上推。浮力抵消了人体的一部分重量。

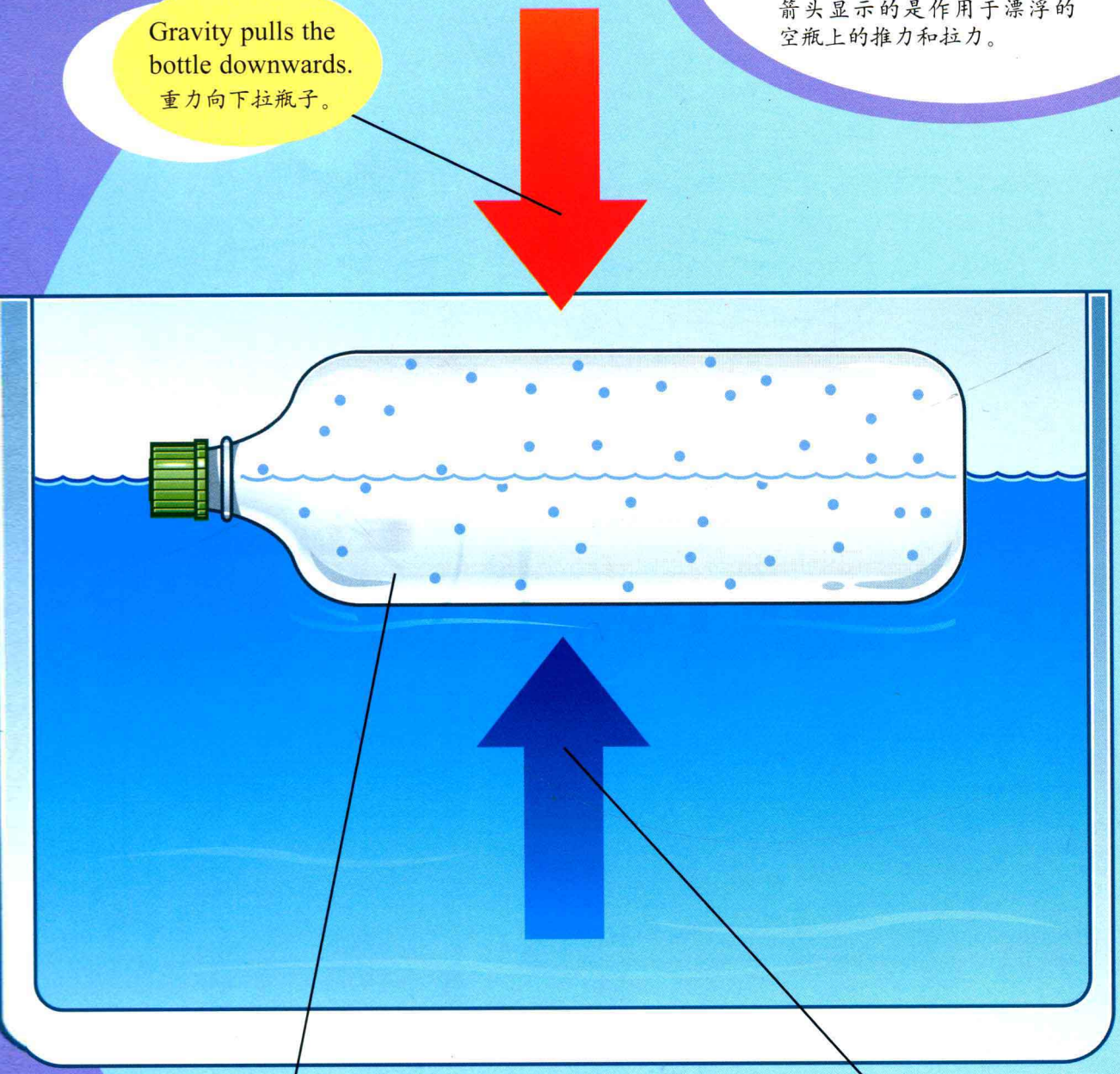
buoyant force (浮力)

▼ The arrows show the forces pushing and pulling on an empty floating bottle.

箭头显示的是作用于漂浮的空瓶上的推力和拉力。

Gravity pulls the bottle downwards.

重力向下拉瓶子。



The buoyant force and the bottle's weight are the same size. They cancel each other out. The bottle floats.

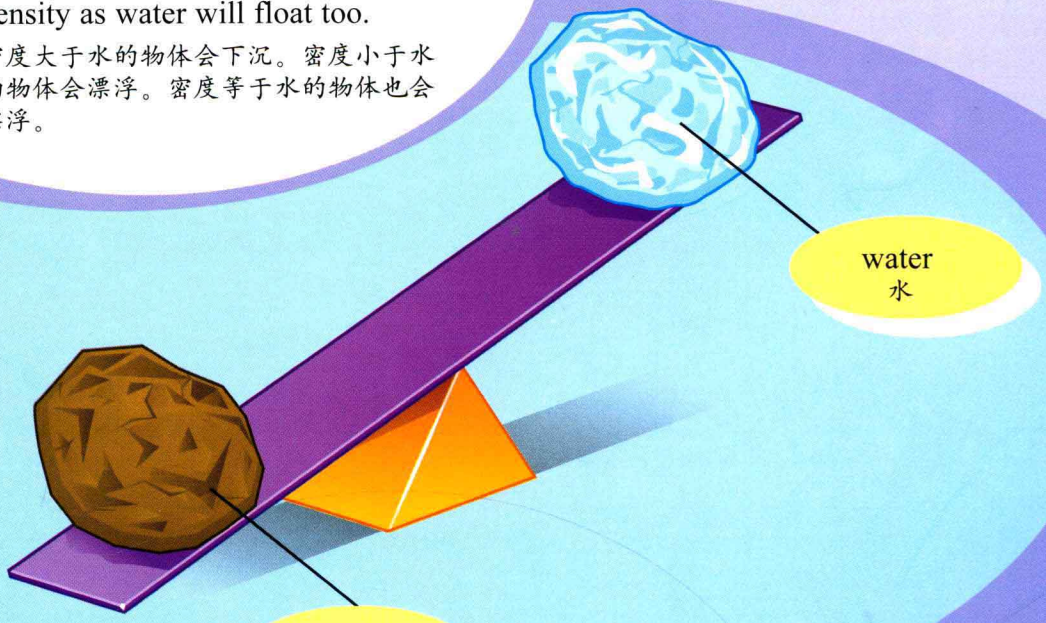
浮力和瓶子的重量相等，它们相互抵消，瓶子漂浮着。

The buoyant force of the water pushes the bottle upwards.

水的浮力向上推瓶子。

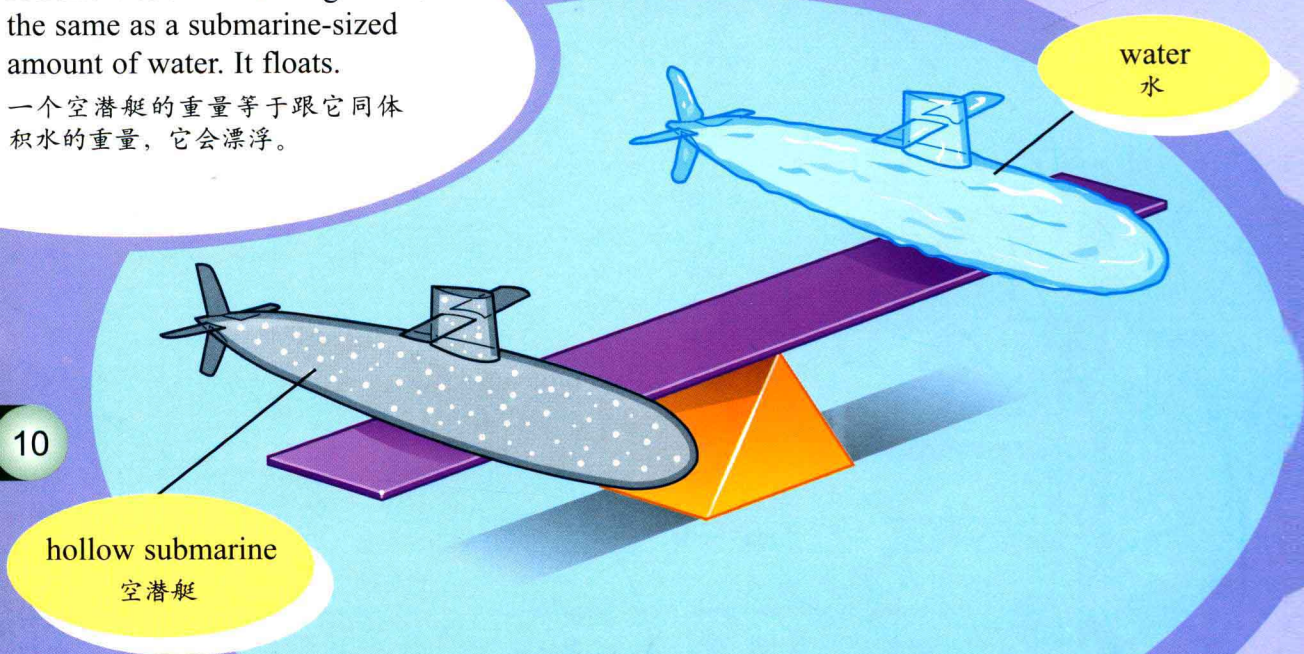
Objects that are denser than water will sink. Objects less dense than water will float. Objects that are the same density as water will float too.

密度大于水的物体会下沉。密度小于水的物体会漂浮。密度等于水的物体也会漂浮。



A hollow submarine weighs the same as a submarine-sized amount of water. It floats.

一个空潜艇的重量等于跟它同体积水的重量，它会漂浮。



Making metal float
让金属浮起来

Weight pulls an object downwards. The object will only float if the **buoyant force** cancels out the weight.

The upward push of water is greater if more water is **displaced**. Displaced means moved out of the way. A stone displaces a stone-sized amount of water. A submarine displaces a submarine-sized amount of water. The buoyant force on a submarine is greater than the force on a stone.

The **density** of the object is important. Density is how heavy an object is for its size. It is the **mass** of an object divided by its size. Mass is how much there is of an object. Metal is denser than water. Solid metal weighs more than the water it displaces. It sinks.

A submarine is made of metal. But it can float. This is because it is **hollow**. There is an empty space inside. This makes it bigger than the same mass of solid metal. It displaces more water. The buoyant force is much greater.

重量使物体下沉，只有当**浮力**抵消了物体的重量时它才会漂浮。

排开的水越多，水向上推的力就越大。排开指水被迫离开原来的位置。一块石头可以排开与其同体积的水。一艘潜艇可以排开与其同体积的水。作用在潜艇上的浮力远远大于作用在石头上的浮力。

物体的**密度**很重要。密度用于描述一定体积的物体有多重。它是物体的**质量**除以体积。质量是指物体所含物质的多少。金属比水的密度大。实心金属比它排开的水的重量大，它会下沉。

潜艇是由金属制成的，但它可以漂浮。这是因为它是**中空**的。它的内部有一个空间。这就使得它的体积大于同样质量的实心金属。它可以排开更多的水，所以浮力就大大增加了。

displace (排开)　density (密度)　mass (质量)　hollow (中空)

Dive! Dive! Dive!
下潜！下潜！下潜！

Submarines have big **ballast tanks**. If the ballast tanks are empty, the submarine is less **dense** than water. It is less heavy for its size. It floats.

To dive, the submarine must get heavier. Its weight must increase to pull it down through the water. Its weight must become greater than the **buoyant force** pushing it upwards.

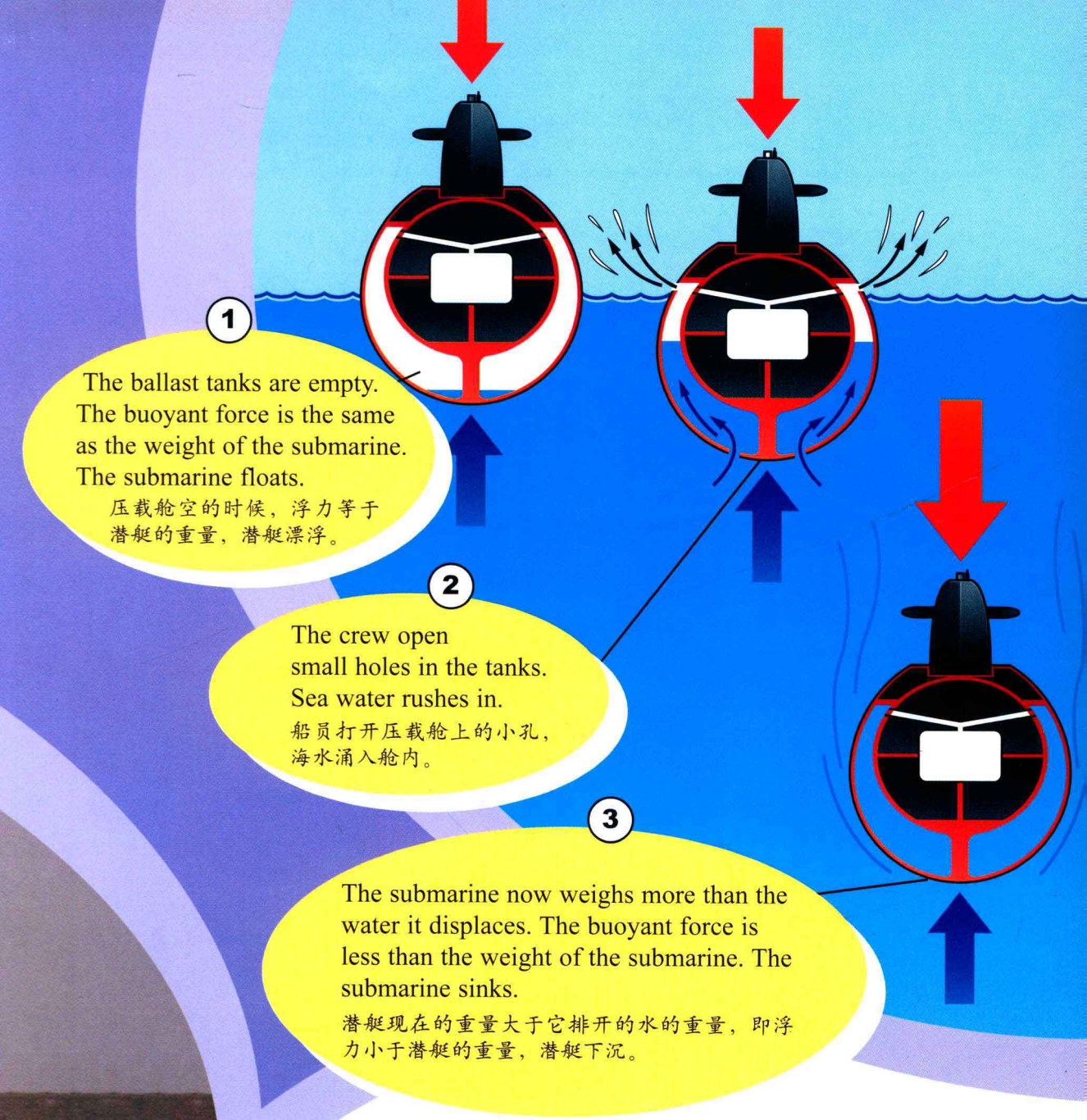
潜艇有很大的**压载舱**。如果压载舱是空的，那么潜艇的密度就小于水。体积大而重量轻，它就漂浮。

为了下潜，潜艇必须增重。它的重量必须增加，才能使自己沉到水下。它的重量必须变得大于将它向上推的浮力。

To dive, a submarine needs to become heavier than the water it displaces. ▼

为了下潜，潜艇要变得比它所排开的水更重。

ballast tanks (压载舱)



To dive, the crew fills the ballast tanks with water. The density of the submarine is now greater. The submarine is heavier than the water it **displaces**. The submarine sinks.

为了下潜，船员会向压载舱中注水。这时候潜艇的密度变大，潜艇比它排开的水重量大，潜艇就下沉。

Water force
水的力量

Water pushes on a diving submarine from all directions. Deep in the ocean, the **force** of water is enormous.

Try crushing an air-filled plastic bottle. It is easy because the plastic is not strong. The force of your hands can squash the air into a smaller space. But you cannot squeeze the air inside a glass bottle. The glass is much stronger than plastic.

水会从四面八方作用在下潜的潜艇上。在深海中，水的**力量**是巨大的。

试着去挤压一个充满空气的塑料瓶子。因为塑料不坚硬，所以很容易挤压。手的力量能把空气压挤到一个较小的空间。但是你无法挤压玻璃瓶子里的空气，因为玻璃比塑料坚硬得多。

A pressing force cannot ▼ squash something with strong walls.
压力挤压不了有坚硬外壁的物体。

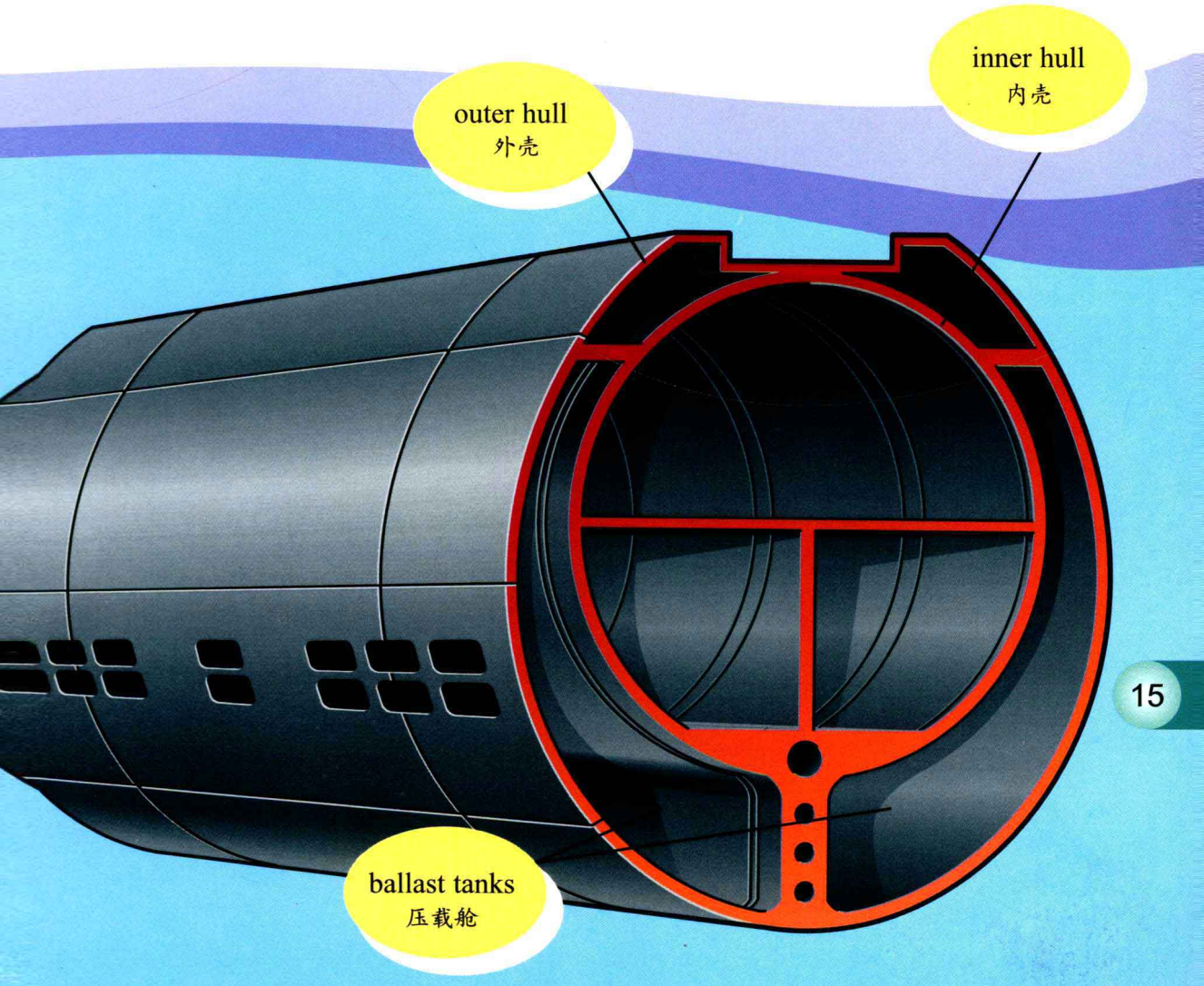
hull (艇体)

Water presses hard on the walls of a submarine. Submarines have very strong walls. They stop the force of the water outside from squeezing the air inside.

The body of a submarine is called the **hull**. It has two layers. The first layer is the outer hull. The second layer is the inner hull. The crew live and work in the inner hull. The inner hull protects the crew. It protects the air that the crew breathe. It stops them being crushed by the force of the water outside.

水强烈地压迫着潜艇的外壁。潜艇有非常坚硬的外壁，外壁使外面的水不能挤压它内部的空气。

潜艇的主体部分叫**艇体**。它分两层，第一层是外壳，第二层是内壳。船员们生活和工作在内壳里。内壳保护着船员，也保护着供船员们呼吸的空气，防止船员和空气受到外面的水的挤压。



On the move
在行进中

Most submarines are powered by **diesel engines**. They burn diesel **fuel** to release energy. The energy turns the **propeller**. The propeller has blades that spin around. It pushes the submarine through the water.

Diesel needs air to burn. The diesel engines are turned off when the submarine dives. The air on board must be saved. The crew need the air to breathe.

An **electric engine** is used under water. Giant batteries store electricity. Electricity is used to turn the propeller. It is used to light and heat the submarine.

The diesel engine is switched back on when the submarine comes to the surface. It recharges the batteries for the next dive.

大部分潜艇由**柴油发动机**驱动。它们燃烧柴油产生能量。能量驱动**推进器**。推进器有叶片，可以旋转。它推动潜艇在水中航行。

柴油燃烧需要空气。当潜艇下潜时，要关闭柴油发动机，以节约空气。因为船员呼吸需要空气。

在水下要使用**电机**。巨大的电池储备着电能。电能用来驱动推进器，它也用于潜艇的照明及保暖。

当潜艇浮出水面的时候，柴油发动机被重新开启。它会为电池充电，以备下一次下潜。

diesel engine (柴油发动机) fuel (燃料) propeller (推进器) electric engine (电机)