



EXPLORING THE DEEP



- 1 Deep in the black of the ocean a shape lurks. Sleek in design, it propels almost silently towards its target. Darkness cloaks the hunter as it approaches its prey. It does not need light to see, for it hunts through sound. The target is close at hand, a ship far above on the ocean's surface. A swarm of bubbles billow out of an opening hatch as a smaller device is fired from within. It snakes upwards at a tremendous speed. Moments later a glowing crystal blooms in the seascape. Oily fire and debris scatter the choppy waters of the surface. How did it happen?
- 2 For many centuries, history and fiction have been filled with dreams of exploring the deep: from kings having tea in a submerged glass jar, to underwater vessels attacked by giant squids. Early submarines were actually built from the mid-1700s onwards, but Irish-American engineer, John

P. Holland, created the first modern submarine in the 1890s. Previous models had used internal combustion engines (like petrol or diesel car motors) or even steam engines to move, but both of these needed oxygen to work. Since there is no breathable oxygen underwater, Holland developed an electric motor for power while the submarine was submerged. This allowed submarines to go completely underwater and stay there for an extended period of time.

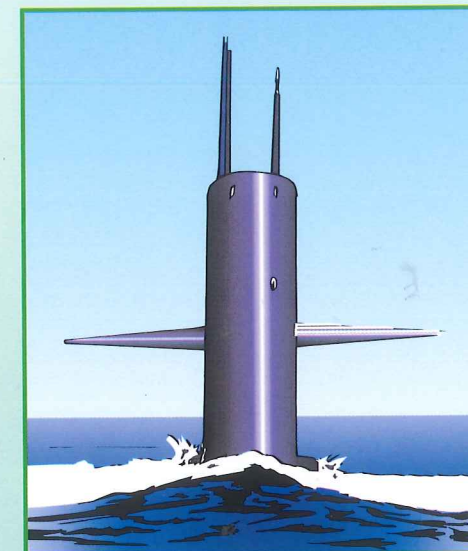
- 3 Submarines can rise or sink in the water due to *buoyancy*. This is the difference between the density (the weight of an object in relation to its size) of the submarine and that of the water surrounding it. A submarine is basically a sealed container surrounded by metal pockets called *ballast tanks*. When the ballast tanks are filled with air the submarine is lighter than the ocean,

so it will float on the top. This is called *positive buoyancy*. If the submarine has to sink, it will fill its ballast tanks with water, pumping the air out. This increase in density gives the submarine *negative buoyancy*, so it will begin to submerge. When the difference between the submarine's and the ocean's densities are equal, the submarine will hover in the water because it has *neutral buoyancy*. To rise back to the surface, the submarine uses compressed air to pump the water back out of the ballast tanks, lightening its load once more.

- 4 A submarine flies like a plane, albeit through the water. So its range of movement is forwards, left to right and up to down. Pilots steer the submarine from left to right with a flat piece of metal, called a *rudder*, which is hinged vertically at the back of the submarine. Moveable wings on either side of the submarine are used to angle the submarine up or down. These are called *hydroplanes*. A large propeller at the back of the submarine provides forward movement. The propeller is made up of several angled blades; the more blades there are, the faster the submarine can accelerate. When these are rotating they force water quickly behind them, causing a thrust that pushes the submarine forward.
- 5 In the past, submarine propulsion was powered by men turning a propeller. Then diesel-powered combustion engines were invented. These motors would run while the submarine was above water and charge up a battery full of energy. When the submarine was underwater the battery would power an electric motor. After World War II, submarine technology really advanced with the invention of the nuclear engine. Unlike combustion, nuclear reactors do not require oxygen so this means nuclear submarines can remain underwater indefinitely. Inside the engine, a nuclear reactor superheats water so that it turns to steam, which is then sent through a pressurised pipe into a turbine motor. The turbine spins a shaft that is attached to the propeller. As the steam cools back to water, it

is pumped into the reactor for the cycle to begin again.

- 6 Navigating underwater can be very different to finding your way around on land. Some submarines, such as those used for research or tourism, have glass windows so the pilot can see where to go. However larger submarines, like those used by the military, have no windows. Older submarines had *periscopes*, a long tube with mirrors that could be raised above the water for navigators to see what was on the surface. Now submarines use a *global positioning system* (GPS), which works out the exact location of objects through radio signals from satellites. While underwater, submarines are able to keep track of targets using sonar. Passive sonar picks up the sound waves of other objects. However, if a more accurate reading is needed the submarine can use active sonar. This is where the submarine emits a sound wave that is bounced back from the target. Active sonar is very similar to *echolocation*, which is what whales and dolphins use to find their way through the ocean.



- 7 Submarines are versatile and although they were first used for warfare, they are now being used for research and tourism. Smaller submarines can be lowered deep below the waves so scientists

can observe the life forms that live there. On 23rd January 1960, the *Trieste* became the deepest diving submarine when it was able to reach the bottom of the Mariana Trench — the lowest point of the ocean at 11,500 metres below sea level. This is even lower than the deepest fish, which are found at 8,500 metres. The depth that a submarine can travel to ultimately depends on the strength of its outer layer — known as the *hull*. The density of water is 1,000 kg per cubic metre, so if you're eleven kilometres underwater you'll have a lot of weight pressing against you. A weak hull will crack like an eggshell under such pressure.

be shrunk down to such a tiny size that they can actually travel through the human body and fight viruses. All of this may sound like fantasy now, but don't forget that submarines were also a work of fiction hundreds of years ago.



8 Already researchers are turning their attention away from the Earth's oceans for the next stages of submarine technology. In the future we may be able to explore the seas on other planets or travel deep through volcanic magma. Even more exciting, though, is the idea that submarines may

Questions

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| <p>1 Electric motors allowed early submarines</p> <ul style="list-style-type: none"> a to go faster. b to stay underwater longer. c to steer the submarine. <p>2 When the ballast tanks are filled with water the submarine</p> <ul style="list-style-type: none"> a will submerge. b will rise to the top. c will have neutral buoyancy. <p>3 The submarine is moved up and down by the use of</p> <ul style="list-style-type: none"> a moveable wings. b the rudder. c several angled blades. | <p>4 What does a nuclear reactor do to water?</p> <ul style="list-style-type: none"> a It turns it into electricity. b It turns it into a turbine. c It turns it into steam. <p>5 How does a modern military submarine navigate underwater if it has no windows?</p> <ul style="list-style-type: none"> a by using GPS b by using sonar c by using its periscope <p>6 Why would a pre-WWII submarine have to surface regularly?</p> <ul style="list-style-type: none"> a to see where the enemy was b to empty the ballast tanks regularly c to provide oxygen for the diesel engines that charged the batteries |
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Vocabulary

Find words in the text that match the meanings below.

The word is in the section shown in brackets.

- 7 To rise up or swell out (1)
- 8 To move faster (4)
- 9 The way something is propelled (5)
- 10 Gives out (6)
- 11 Having many skills or uses (7)

Alphabetical Order

The following words appear in the text.

When placed in alphabetical order, which one would be **first**?

- 12 negative, nuclear, needed, neutral
- 13 previous, propeller, pressurised, propulsion
- 14 surface, submerged, surrounded, submarine
- 15 both, basically, ballast, back

Back To The Text...

- 16 What has the illustrator used to show the 'O' in the title?
 - a an alien's eye
 - b an eye in a periscope
- 17 In section 8, "submarines may be shrunk down ..." is?
 - a fact.
 - b opinion.

18 What would be a good sub-heading for section 4?

- a Moving Around
- b In the Future

Cloze

Super Ships

Choose **five** of the following words to complete this cloze passage.

design submarine famous rocks
ship originally sails hulls

In 1843, Isambard Kingdom Brunel, the 19 English engineer, completed the SS *Great Britain*. This was the first steamship to have an all-iron hull. Previous to this time, 20 were usually made of timber. Fifteen years later, Brunel launched the SS *Great Eastern*, the largest ship of its time. This monster, which was 21 to be called the SS *Leviathan*, was propelled by sail, paddle wheel and propeller. Its clever 22 included an inner and an outer hull, which saved it from sinking when it tore its outer skin open on submerged 23 near Long Island in 1862.

Challenge Option

Research: Some people use a bathyscope to view underwater. What do they look like?

