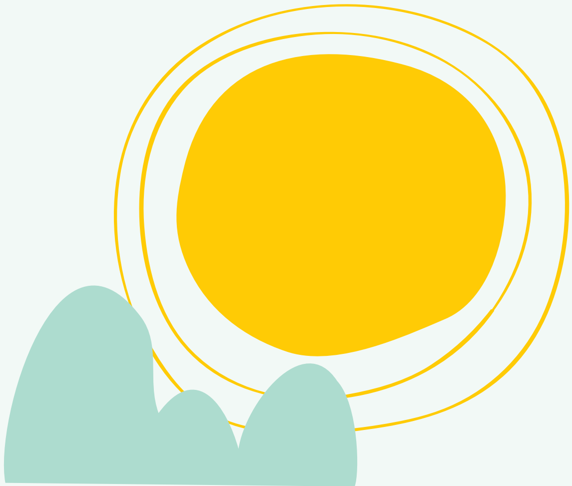
Explorers learning about Squid



Cephalopod Science Investigations

LEARNING ABOUT SQUID 101

By Cushla Dromgool-Regan
Eimear Manning & Anna Quinn

www.EXPLORERS.ie
The Explorers Education Programme is funded by the Marine Institute

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Explorers learning about Squid

Explorers Education Programme engage with primary schools, teachers and children, creating marine leaders and ocean champions. The Explorers Education Programme team provides engaging activities, resources and support for teachers, children and the education network, delivering ocean literacy to primary schools.

We aim to inspire children and educators to learn about our marine and maritime identity and heritage, as well as making informed and responsible decisions regarding the ocean and its resources.

We communicate about the ocean in a meaningful way, increasing the awareness and understanding of our marine biodiversity, the environment, as well as the opportunities and social benefits of our ocean wealth.

To help inspire children learning about the ocean, we have developed a series of teaching materials and resources about Squid! Check out our Explorers books: Cephalopod Science Investigations – Learning about our favourite Squid; My CSI Squid Workbook. Also, see our interactive film: Cephalopod Science Investigations – Learning about Squid 101 and Dissection.

For more information about our Squid series see www.explorers.ie

Explorers learning about Squid

CEPHALOPOD SCIENCE INVESTIGATIONS

LEARNING ABOUT SQUID 101

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CSI LEARNING ABOUT SQUID

We love cephalopods - especially SQUID! Scientists and engineers all around the world are inspired by this amazing marine creature. They have sent squid to space for research and others are investigating their evolution. Technology has also been developed to try and find illusive squid in the deepest parts of the ocean.

We hope this book **CSI: Learning about Squid 101** helps inspire you to learn about these incredible creatures too.

1. **Types of cephalopods.** Learning about squid and its relatives.

2. **They have been around for a long time.** Understanding the differences between cephalopods.

3. **Squid anatomy: What makes a squid a 'squid'!** Investigating squid's external and internal features, from its head to its tentacles!

4. **Where squid hang out!** Discovering where squid live.

5. **Squid - all shapes and sizes!** Learning about some of our favourite squid from the Atlantic to the Southern ocean.

6. **Squid are kraken!** Sharing the stories about the sea monster called the Kraken.

7. **Cephalopod connections.** Being inspired by how squid influence us! From yummy food, science and research, to squid in space!

8. **Squid Facts - that's a Wrap!** Sharing some of our favourite squid facts!

TYPES OF CEPHALOPODS

Cephalopod (sefo-low-pod) means 'head-food', which means 'head-foot', which suits these creatures well, as their arms and tentacles (feet) are attached to their heads.

There are four main types of cephalopods. They are known as the nautilus,

Scientific name: Nautilidae

Scientific name: Sepiida

Scientific name: Octopoda

Scientific name: Teuthida

CEPHALOPODS come from the **MOLLUSC** family (or phylym). This means they belong to the large group of animals that have soft bodies and no true bones.

These animals are known as **INVERTBRATES**. Having no backbone, they are therefore related to snails, clams, and even slugs.

FUN FACT

The Irish name for common squid is SQUID CHOITIANTA. It is also known as MÁTHAIR DÚCH which means 'mother of ink'.

THEY HAVE BEEN AROUND FOR A LONG TIME...

The cephalopod ancestry dates to the Ordovician period. This means that cephalopods are older than trees!

It is likely that most of the cephalopod species were wiped out by the same worldwide disaster that killed the dinosaurs 65 million years ago.

In their evolution, cephalopods had tough protective shells covering their body, but over millions of years, many (apart from the nautilus) lost their outer shell. The cuttlefish, octopus, and squid traded their outer shell for some new adaptations, such as higher intelligence, incredible camouflage, and flexible arms.

Scientists have discovered **17,000** cephalopod fossils

There are approximately **800 species alive today**

Including **300** different types of squid

NAUTILUS

The oldest nautilus on record appeared 265 million years before dinosaurs! The nautilus is now the only cephalopod that still has a shell surrounding its body. Inside the shell are pockets of air called 'chambers'. The nautilus can change the amount of air in its chambers to allow it to float or sink.

CUTTLEFISH

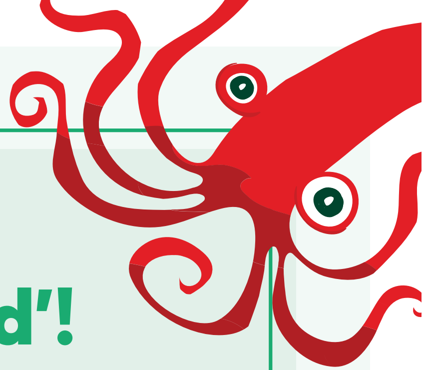
Similar to the nautilus, cuttlefish use the chambers inside its 'cuttlebone' to control its buoyancy. The cuttlebone is inside the body of the cuttlefish. Cuttlefish are masters at changing colour. Many can also change their body's texture! This allows them to blend into rocks and coral reefs.

OCTOPUS

Octopuses have shown to be extremely intelligent. Scientists believe an octopus could have the same level of intelligence as a human toddler! In 2009, biologists studying the octopus reported that an octopus was seen using half a coconut shell as portable protection. This was the first example of an invertebrate (an animal with no backbone) using a tool to keep itself safe.

SQUID

There are around 300 species of squid. Although most squid will live alone, like the rest of their cephalopod cousins, some species of squid live in schools of millions (or even billions)! Certain species of squid are also the deepest-living cephalopods and have been found over 1,100 metres below the surface. The eyes of a colossal squid are believed to be the biggest eyes in the animal kingdom. They are about 25 – 30 cm in diameter. That's the size of a football!



SQUID ANATOMY
What makes a squid a 'squid'!

THE SQUID'S EXTERNAL FEATURES

Squid come in all shapes and sizes but generally have a torpedo shaped body structure and highly developed sensory systems. They also have three main parts of the body. This includes its arms and tentacles, the head and large eyes, and the sac-like mantle and fin.

MANTLE

The squids main part of its body is called a mantle. This mantle is made up of muscle and skin and fits like a sheath over the squids internal organs.

HEAD, ARMS & TENTACLES

Squid have a small compact head, where the squids tentacles and arms are attached.

Cephalopods (apart from the nautilus) have eight or ten arms that surround the mouth.

Squid belong to a super group called decapodiformes. These are animals with ten 'feet' – and most have eight short arms and two long tentacles.

SUCKERS

The squid's arms have rows of suckers down the entire length of the arm. However, the squid's tentacles only have suckers at the far end of this body part. When extended it looks like a hand or a club with suckers.

Most cephalopods have teeth or hooks in their tentacle suckers. The nautilus is the only species to have toothless suckers – they are more like adhesive ridges.

A nautilus has two rings around its mouth that include 90 retractable tentacles. Its tentacles have grooves and ridges instead of suckers.

Cuttlefish have eight arms and a pair of long tentacles.

An octopus has eight arms and no tentacles.

MOUTH, BEAKS & RADULA

Squid have a mouth at the centre of its arms and tentacles. The mouth is surrounded by a fleshy tissue that is called the buccal cavity (which are essentially the squid's lips).

However, what squid are known for are their beaks. The squid's beak is made up of chitin – which is the same material found in our fingernails.

The beak is made up of two parts. The top beak has a sharp hook and the bottom is broader. The squid's beak looks very similar to an eagle's or parrot's beak. The shape of the beak makes it an excellent tool for crushing tool for crushing small crustaceans, such as crabs, shrimp, or prawns.

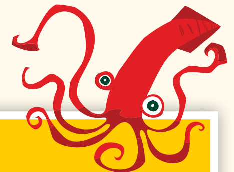
Inside the beak the squid has a sharp radula, which is similar to a tongue. This is used to help chew up the food and push it down the squid's throat.

FEEDING & FIGHTING

Squid are carnivores. They love small fish, crabs, shrimp, and will also eat other squid!

A squid will stalk its prey and reach out to grab its food with its long tentacles.

The squid will then pull its prey into its arms and holds it in place with its suction cups. The squid then uses its tentacles to feed the prey into its mouth.



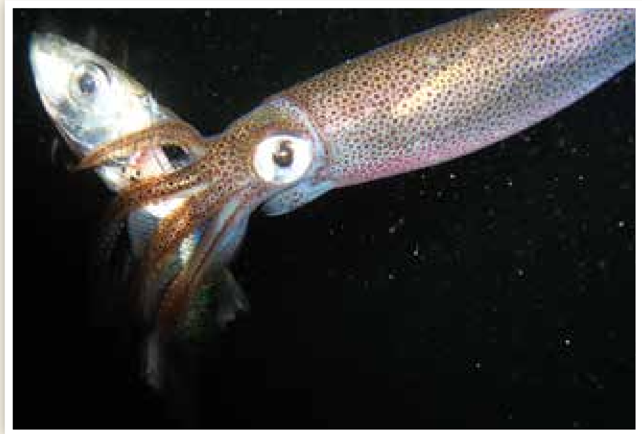
FUN FACT

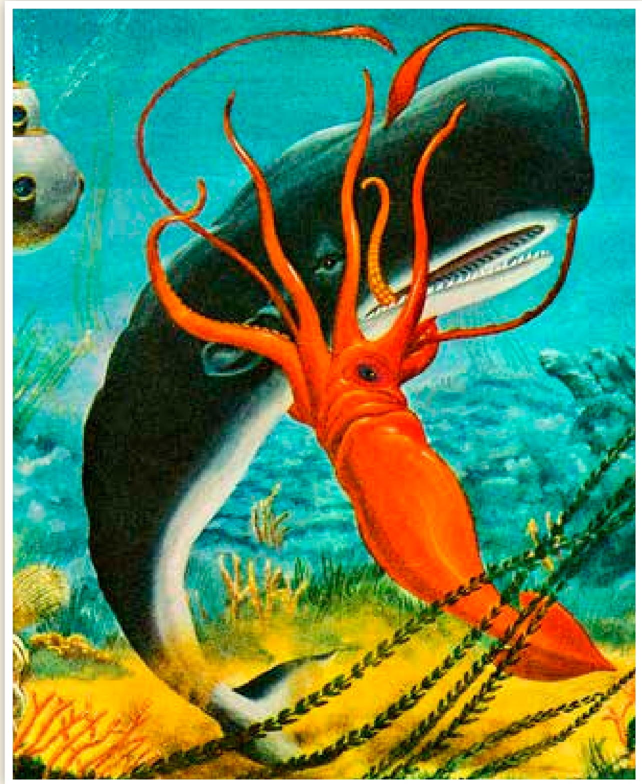
Scientists believe that a squid can eat a third of its body weight in a day!

There are lots of animals that love to eat squid. This includes birds, sharks, tuna, and other larger fish. Toothed whales particularly love squid too.

The colossal squid are believed to be able to fight with sperm whales. Some say the squid can use its tentacles to wrap around the whale and drag it down into the deeper parts of the ocean. The squid's goal is to try to drown the whale to avoid being eaten.

Scars recorded on the bodies of sperm whales indicate that they regularly battle with the colossal squid and win. A number of colossal squid beaks have been found in the stomachs of sperm whales.





FINS & SIPHONS

Squid come in all shapes and sizes, which affects how they swim.

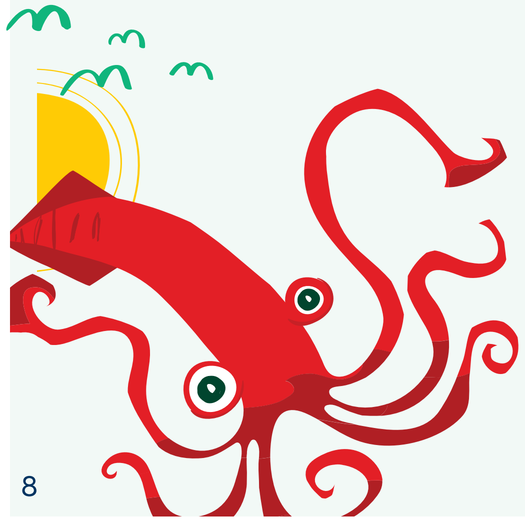
Some squid are denser than sea water and therefore must keep swimming to stop from sinking. Other squid have nearly neutral buoyancy which means they neither sink or float.

Squid use their fins and siphon to help them move. Squid have two fins at the top of its mantle that look like wings. They use these fins to steer and stabalise themselves in the water, and also propel themselves when swimming at slow speeds.

The squid's fins are very flexible and can move easily in the water to help them change direction, much like a rudder of a boat.

FUN FACT

Japanese flying squid can fly above the water, covering distances of 30 metres per jump!



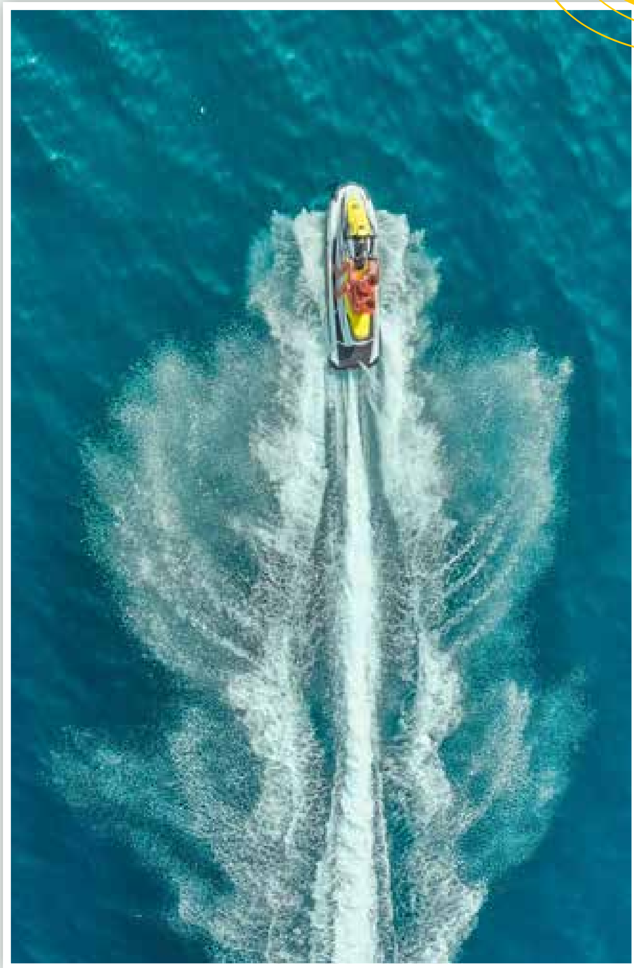
Squid are very fast swimmers. They will propel themselves through the water extremely quickly using a technique called 'jet propulsion'. This is similar to how a jet ski moves through water.

The squid will pull water into its muscular mantle cavity. The mantle inflates like a balloon. The squid then squeezes its body and pushes the water out through the siphon, which is like a funnel. The squid shoots backward, tail first.

The squid can also point the siphon in different directions to steer.

FUN FACT

When seen swimming together, scientists and divers have described squid as moving like a swam of bees!



EYES & BRAIN

The squid brain is enclosed between the large optic lobes or eyes in its head. Scientists believe that up to 80 per cent of the brain is used for processing visual information.

A squid's eyes are located lateral to the head. This means they have one eye on each side of the head. In the past it was thought the squid had one eye. This belief may have come from stories from fishermen who spotted squid swimming beside their boat and there was only one big eye looking up at them. Many years later when they first caught a squid they realised that there was a second eye on the other side of the squid's body.

A squid's eyesight is very good, but it doesn't see in the same way as humans. It is actually colour blind, and so it responds more to the changes in light intensity and brightness rather than colour.

Some squid live in the deep ocean, and can spot the tiniest amount of movement in near darkness!

A squid's eye is very big in relation to their bodies

FUN FACT

A squid's brain is very small and shaped like a doughnut

SKIN & LIGHT SENSORS

Many cephalopods can change colour using special cells in their skin called chromatophores.

When the chromatophore opens wide it makes the animal look darker. If the chromatophores are relaxed the animal looks paler.

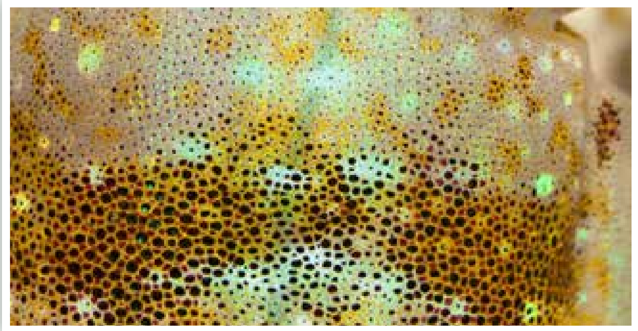
Each cell contains a different coloured pigment of red, brown, orange, or yellow. The cells can open and close really quickly, about four times per second.

The squid will use its chromatophores to change colour for many reasons. This includes confusing predators, attracting mates, as well as communicating with other squid. They can also camouflage into their environment to hide from predators.

Squid also use a technique called 'flashing' while hunting. This means they flash their colours really quickly which can stun its prey, giving the squid a few extra seconds to swim up to ambush and catch it.

Many squid and cuttlefish also have 'photophores', which are tiny organs in the skin that can produce their own light. This is called 'bioluminescence'.

Cephalopods change colour faster than a chameleon



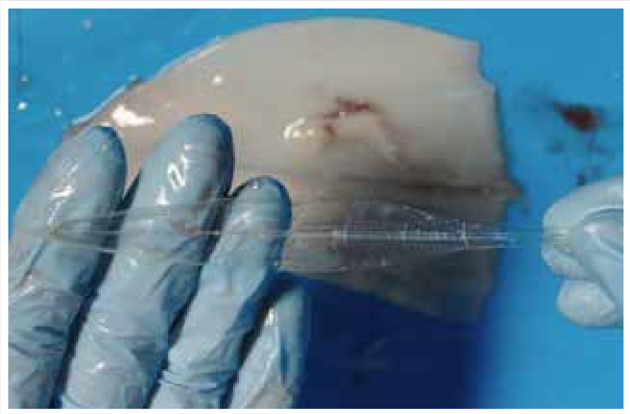
Squid & cuttlefish have skin that can produce their own light!

FUN FACT

Scientists believe that squid are so sensitive to light, they can see with their skin.

THE SQUID'S INTERNAL FEATURES

The squid's interal body parts help it breath, digest food, excrete waste, and reproduce.



GLADIUS

A squid doesn't have bones. Instead it has a gladius. Gladius is Latin for 'sword'. The squid's gladius (or pen) is shaped like sword or a feather. It is made of chiton and helps to support the squid's muscles and organs.

GILLS, HEARTS & BLUE BLOOD

Squid have two gills, three hearts, and blue blood!

While dissecting squid, scientists will often find a pair of long feathery gills. These are used for removing oxygen from the sea water for breathing. Located between the top of the two gills is the main heart, which is peachy in colour. At the top of each of the gills, the squid also have muscular bulbs known as gill hearts, which are white in colour. Therefore, it is true. Squid have three hearts!

The squid's circulatory (blood) system is different from other molluscs. It is considered to be 'closed'. This means that blood is transported around the body through its arteries, capillaries, and veins. The squid's blood is blue! This is caused by a copper compound called haemocyanin. In humans, the blood is red due to the iron compound haemoglobin.

INK SAC

Many cephalopods can produce ink. Squid ink is almost entirely made up of melanin produced by its ink gland.

Melanin is what gives our hair and skin its colour. Squid store the ink in an ink sac. When they feel under threat or want to hide they will expel a cloud of dark ink in order to confuse predators.

LIFE & REPRODUCTION

The gonad is the squid's reproductive organ. If the squid is female, the gonad will have clear, jelly-like eggs in it. If the squid is a male then it will have white stringy-like milt inside.

Female squid also have a nidamental gland. This is a large white organ, which sits on top of the other internal organs and is used for coating the eggs in healthy bacteria before they are released into the water.

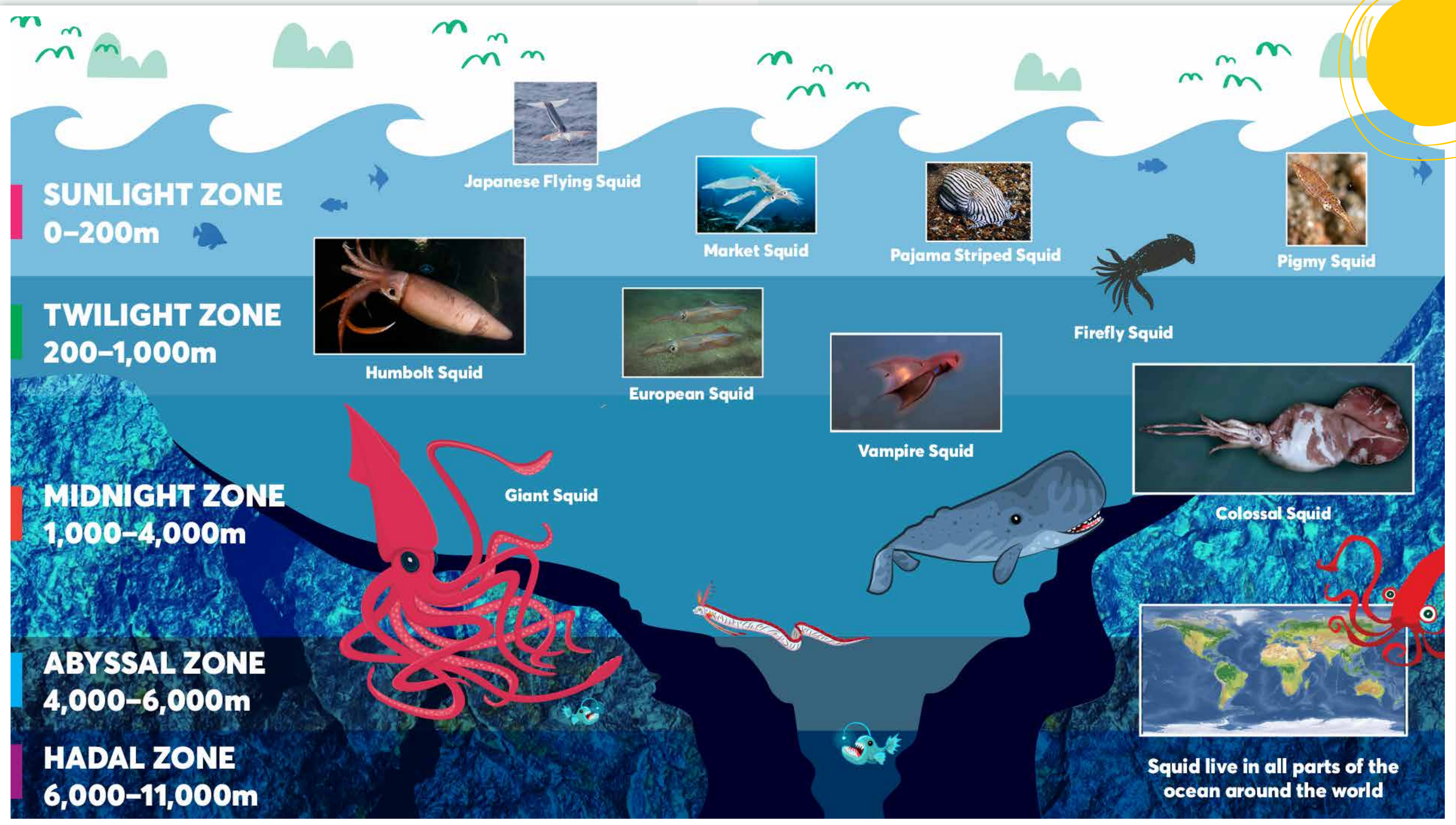
The females deposit their eggs in clusters on the seafloor. They look like finger-shaped gelatinous capsules and are often attached to algae or other features. Squid egg masses are communal, meaning that more than one squid will contribute to the egg deposit. Each capsule holds up to 200 eggs.

WHERE SQUID HANG OUT!

Cephalopod species are found in all the world's ocean basins including the Atlantic, Pacific, Indian, Artic and Southern. They live in all types of ocean waters ranging from the tropics to the coldest depths of the ocean.

Most squid are usually found at depths of 300 - 600 metres below the surface of the ocean. This is an area known as the TWILIGHT ZONE. Scientists believe that squid stay at these depths during the day and surface to the SUNLIGHT ZONE at night, following food sources such as shrimp.

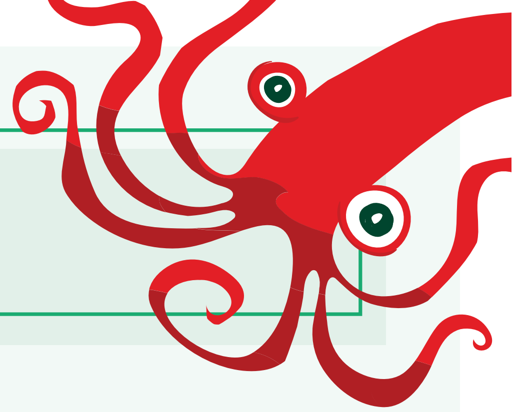
Other cephalopods, such as the giant squid, live deep underwater at 2,000 metres in the MIDNIGHT ZONE. They are well adapted to the dark, where the sun never penetrates. Because of this, they are also extremely difficult to find!



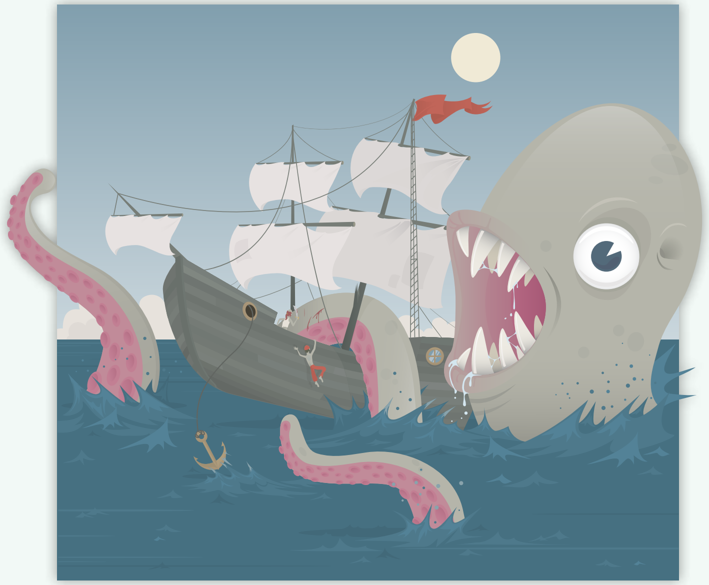
FUN FACT

In 2012 the giant squid was filmed in its natural habitat for the first time ever!

SQUID ARE KRAKEN'



SEA MONSTERS – THE MIGHTY KRAKEN!



Humans have been fascinated with cephalopods for over 2,000 years. These alien creatures would wash up dead on beaches from time-to-time, but people had no idea what these sea creatures were. Were they sea serpents? Maybe they were mermen? Sea monsters with bodies covered in tentacles? The most famous mythological cephalopod is the mighty kraken, which was said to be able to break ships in half in order to eat the sailors aboard.

The name 'kraken' comes from the old Norse word 'kraki', which means 'a deranged or twisted animal'. Some people even believed that the kraken was responsible for the extinction of the ocean-dwelling ichthyosaurs during the Triassic Period.

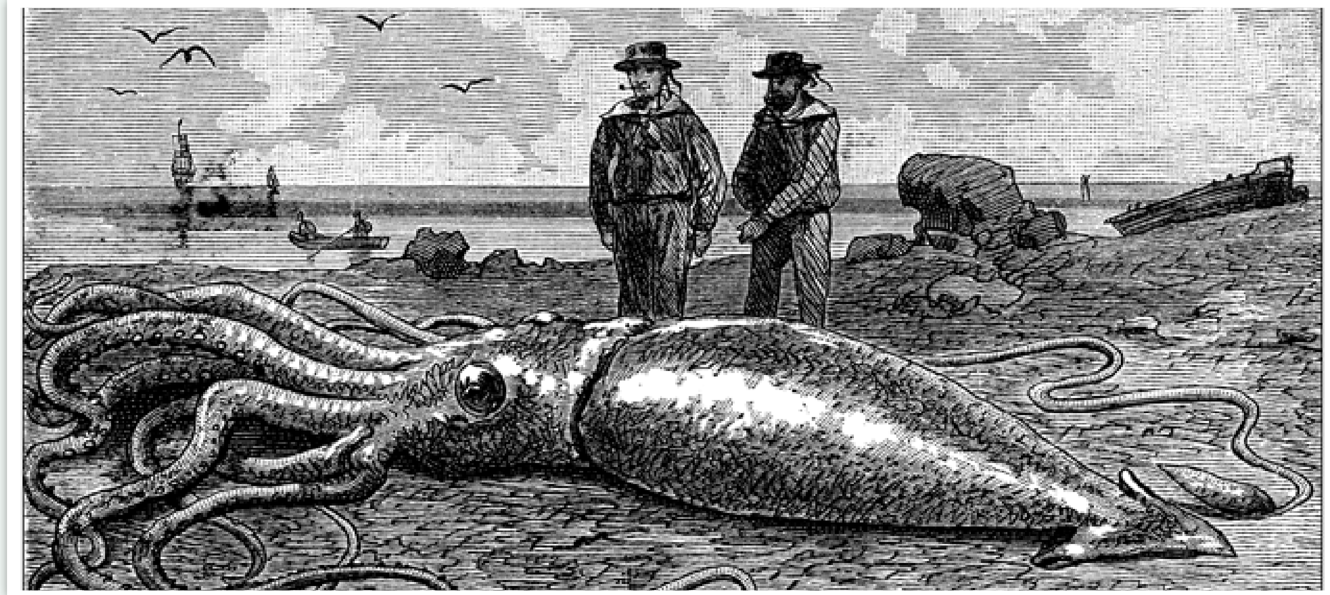
Possibly the most famous story of the kraken was written in 1870 by French author Jules Vernes. His novel 20,000 Leagues Under the Sea describes a monstrous squid, hungry for human flesh.

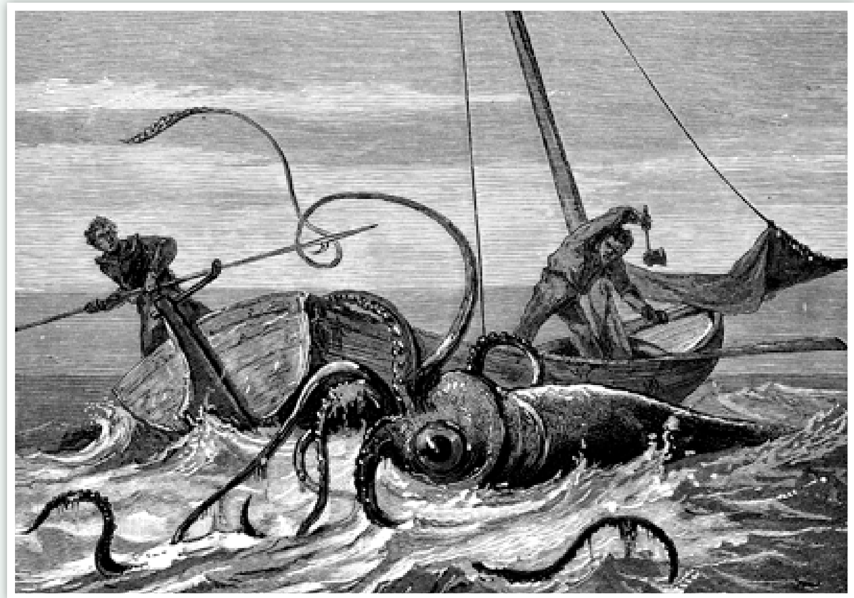
It was said that the creature 'could entangle a ship of five thousand tons and bury it into the abyss of the ocean'.

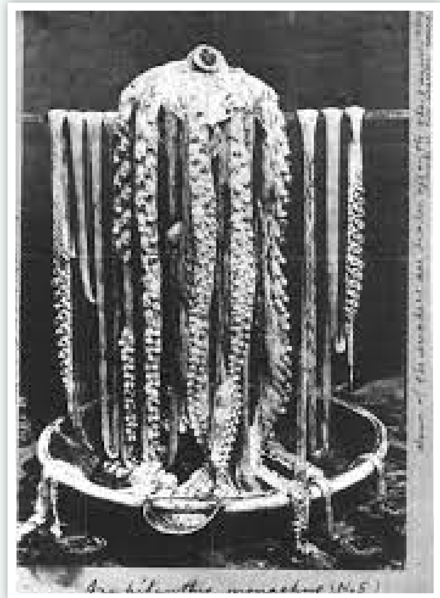
Disney created a movie based on Verness novel, and included a fake monster-squid. It weighed the same as a van, and took 66 men and women to operate it! The legendary kraken still finds its way into movies, books, and television shows today. From Marvel Comics, to the Pirates of the Caribbean films, the kraken lives on in popular culture.

Today, science continues to help us unveil the mysteries surrounding these rare and elusive species. For example, we now know that these massive squid are not monsters at all. We know that they don't hunger for humans, and that they can't break ships in half with their tentacled arms.

Most likely these sailors were spotting giant squid, and were frightened by its enormous size. Giant squid have the Latin name *Architeuthis dux*, which means 'ruling squid', but despite their scary name there's no reason to fear squid of any size!







CEPHALOPOD CONNECTIONS

YUMMY FOOD & FISHING

Squid are eaten by humans across the globe. In English the squid dishes are named as calamari. We love to use their ink in cooking to make our food black – like black spaghetti.

In 2015, humans caught over 3 million tons of squid across the world, which was valued at over 8 billion euro!

We also love squid rings – yum!

INSPIRING TECHNOLOGY

Cephalopods have been a very important inspiration for scientists and engineers.

Scientists are researching squids' amazing ability to change its skin colour to see if they can create similar adaptive camouflage for things like clothing or cars.

FUN FACT

NASA are sending baby bobtail squid to the International Space Station. This experiment is to help them learn more about keeping astronauts healthy during long space missions.

Engineers have been inspired by the octopus, creating a flexible robotic arm. This is to be used for accessing hard to reach areas of the body during surgery. Scientists are also examining cephalopod suckers to see if they can create a tool that can pick up items and hold them.

As squid are an important food for game fishing (large fish caught by anglers often for competitions), many fishing lures have been developed to look, move, and even shimmer like squid.

CEPHALOPODS & THE CLIMATE

Climate change is making the ocean warmer. This is causing a lot of stress for many ocean species. However, in 2016 fishermen and marine scientists in Australia discovered that cephalopods are actually growing in population size.

There may be a down-side to this expansion. As cephalopods are mighty predators, they have the potential to gobble up many other marine species. This may cause problems for other fish and marine life who are trying to survive.

Warming waters are making it much more difficult for species to grow their shells. This could be a big problem in the future for shelled-cephalopods such as the nautilus specie.

Understanding these animals and their environment helps us all learn more about how we can work together to ensure that all ocean species are safe, healthy, and happy. A healthy ocean equals healthy people!

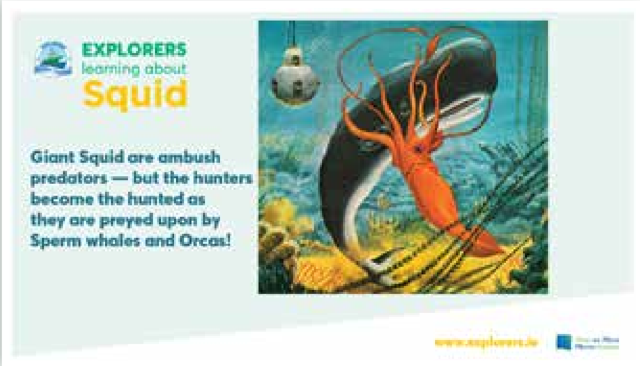
RESEARCH IN IRISH WATERS

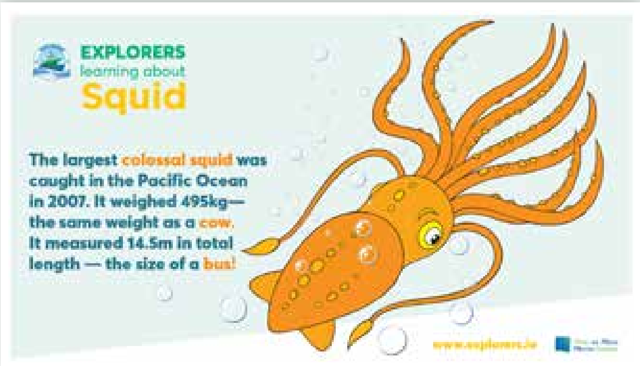
In Ireland, marine scientists have joined researchers around the world learning about cephalopods.

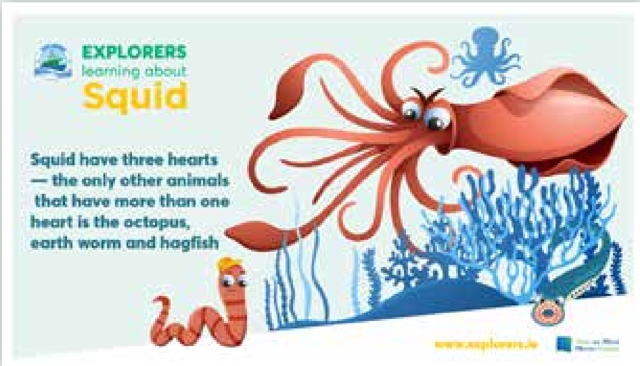
They work with fishermen and collect scientific information on research vessels about cephalopods, including squid. Some scientistis have captured film fotage of squid using the ROV (remotely operated vehicle) while researching cold water corals and the deeper parts of the ocean.

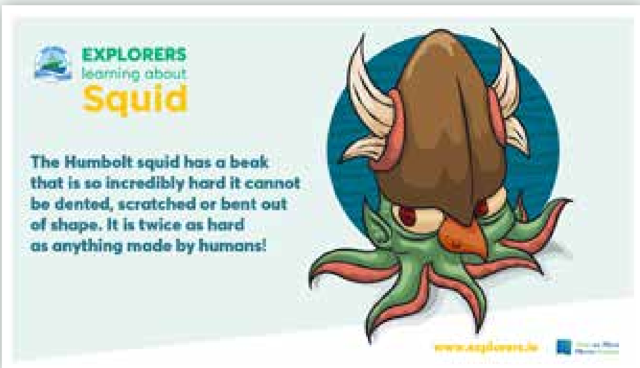
The scientist's research helps us learn about the evolution of cephalopods, their distribution around the world and the types of habitats they like to live in. Understanding what they eat, how they reproduce and their changing bodies also helps us us unravel the many other mysteries of the deep.

SQUID FACTS - THAT'S A WRAP!









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USEFUL LINKS

https://www.nationalgeographic.com; https://animaldiversity.org/; https://oceana.org; https://earthsky.org; https://www.marinebio.org/; https://www.marlin.ac.uk; https://www.aquariumofpacific.org; https://oceanconservancy.org; https://www.fisheries.noaa.gov; https://ocean.si.edu/; https://www.sealifebase.ca; https://www.tepapa.govt.nz/

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