NATURAL HISTORY MUSEUM

Life in the Dark

Exhibition text in large print

Please do not remove from the gallery

This large print guide has been produced for *Life in the Dark*.

The exhibition is divided into four zones, each with text panels and captions.

Life in the dark

Leave the sunlight behind and venture into the dark.

Travel to places where moths dance in the moonlight, bats dangle in caves and strange sea creatures lurk in the ocean depths.

Enter these worlds and come face-to-face with the creatures that live there.

Discover their stories, feel their surroundings and explore their lives.

This is Life in the Dark.

Life at night

As the last light of the day fades, resist the urge to sleep and come with us into the night.

Foxes emerge from hiding, badgers sniff out tasty meals and frogs serenade potential mates.

From cities to countryside, jungles to deserts, creatures of the night are thriving.

Who will you find?

Sight

As the Sun sinks below the horizon, nocturnal creatures emerge and venture into the darkness to forage, hunt and find a mate. In the absence of daylight, these animals rely not only on their sense of hearing, touch and smell but also on their sense of sight.

Although we struggle to see clearly in the dark, many nocturnal animals have excellent night vision. Their eyes are adapted to make the most of the light from the Moon, stars, streetlights and buildings. In these limited light conditions some creatures have evolved to see in detail but only in black-and-white, whereas others have adapted to see coloured but blurry images.

1. Tuatara

Sphenodon punctatus

The eyes of this reptile have a layer called the tapetum lucidum (*ta-pee-tum lou-see-dum*) that reflects light back through the retina. This means light passes through the retina twice, strengthening the image. Some of the reflected light escapes through the front of the eyes, making them shine.

New Zealand
1935.5.14.2

2. Net-casting spider

Deinopis sp

This net-casting species has the largest eyes of any spider. Its eyes are 2,000 times more sensitive than our eyes, enabling it to spot prey at night. Waiting for passing insects, it dangles from branches and then pounces with its springy net.

Southern Hemisphere

19.9.18.5731

3. Tawny owl

Strix aluco

Tawny owls have large tube-shaped eyes that allow them to see brighter images at night by making the most of any moonlight. This means they can fly through the forest in the dark without bumping into branches as they hunt.

Europe and the Middle East

1996.41.3638

4. Oryba sphinx moth

Oryba kadeni

The oryba sphinx moth's eyes are extremely large and so are able to take advantage of any available light. Their brain also processes what they see more slowly, which helps the moth to see more detail in the dark.

Central America and northern South America
NHMUK010891883

5. Owl monkey

Aotus trivirgatus

This is the only nocturnal species of monkey in the world. Its eyes are larger and rounder than those of monkeys that are active during the day, which means they absorb more light. This allows the owl monkey to see shapes and detail in the dark.

Northern Amazon Basin
1970.343

6–7. Tarsier and tarsier skull

Tarsius spectrum

Look at the large eye sockets in the tarsier's skull. Compared to the size of its head, it has the largest eyes of any mammal – each eye is the same size as its brain. Tarsiers can see detail in the dark, but only in black-and-white.

Indonesia
1984.1888, 8.7.17.5

How an eye works

Light is focused by the lens onto the retina. Photoreceptors in the retina absorb the light and send signals to the brain to form an image.

Lens: focuses light that enters the eye

Tapetum lucidum: layer of reflective cells behind the retina that some nocturnal animals have

Optic nerve: nerve that connects the retina to the brain

Pupil: hole in the centre of the eye that allows light in to reach the retina

Retina: layer of photoreceptor cells in the back of the eye

Photoreceptor cells

Rods: sensory cells that work in low light levels, helping animals to see in the dark

Cones: sensory cells that pick up different wavelengths of light, helping animals to see in colour

1. Tiger-leg monkey frogs

Callimedusa tomopterna

Scientists from the Natural History Museum collected these frogs on a recent field trip to French Guiana. Studying specimens such as these brightly coloured tiger-leg monkey frogs will help scientists to understand frog vision.

Central America and South America
2016.707–708

2. Male and female common tree toads

Rentapia hosii

These toads mate at night, but how do the males find the females in the dark? Scientists think that these toads can see in colour and that the females have evolved to be bright blue with yellow spots so that the males, which are dark brown, can spot them at night.

Southeast Asia
1904.7.19.19–20

Creature of the night

The aye-aye has teeth like a rodent, a tail like a squirrel and hunts for food like a woodpecker. This mix makes the aye-aye particularly unusual.

Super-sensitive ears pick up the vibrations and movements of grubs and larvae hidden beneath the tree bark.

Large eyes help it to see in the dark by letting in as much available light as possible.

Long bushy tail helps it to balance and move through the forest.

They use their extra-long middle finger to tap along the surface of a tree to help locate insect larvae.

Toes tightly grip branches.

1–2. Aye-aye skeleton and aye-aye

Daubentonia madagascariensis

The aye-aye is the largest nocturnal primate in the world. It has such a curious mix of adaptations that the scientists who first encountered it more than 200 years ago weren't sure what type of animal it was.

Madagascar

1984.1883, 1982.462

Sound

The night is far from silent! From serenades to alarm calls, an entire chorus of noises erupts after dark. Sounds travel differently at night – the cooler air temperatures carry soundwaves more slowly and towards the ground, which means they can be heard from further away. Calls, croaks and songs carry in the darkness helping animals to find each other as they search for a mate.

But making sound can be dangerous. Supersensitive ears detect the tiniest scuttles and the quietest of squeaks, helping predators to home in on their prey. Those under threat must rely on their sharp hearing and quick reactions to evade the talons, teeth and beaks of their attackers.

European rabbit
Oryctolagus cuniculus

The large ears of rabbits can pick up the quietest of sounds, including vibrations made by predators. At night they listen out for animals moving above the ground to determine whether it's safe for them to leave their burrows to feed.

Europe, North Africa and Australia
AQ-PEG-2018-3-LER

Please touch

1. Male kakapo

Strigops habroptilus

The kakapo has a unique night-time mating ritual. Males dig a bowl-shaped hollow in the ground, sit in it and make low-pitched booming noises to attract females. The shape of the burrow amplifies the sound, which can travel up to one kilometre.

New Zealand
NHMUK 1945.58.4

2. Male tokay gecko

Gekko gecko

Under the cover of darkness the tokay gecko can be heard calling ‘gecko-gecko’. This is where the name gecko comes from. The males make the sound to serenade females or if threatened by other males.

India and southeast Asia

1856.11.17.31

3. Male common milk frog

Trachycephalus typhonius

Can you see the large vocal sacs on each side of this frog's head? Male common milk frogs make distinctive croaking noises at night to attract females. These vocal sacs amplify the sound so that males have the best chance of being heard above the night-time chorus.

Central America and South America
1932.9.16.41

4–5. Male and female European mole crickets

Gryllotalpa gryllotalpa

Male mole crickets sing at night to attract females. They dig a small burrow that is perfectly shaped to tune a harmonious sound and reflect it upwards. When a female hears a song she likes, she drops down into the burrow to mate.

Europe

NHMUK010210862, NHMUK010210822

6. Barn owl

Tyto alba

The heart-shaped faces of barn owls help to catch and direct sound towards their ears. With one ear higher than the other, they can pinpoint exactly where a noise is coming from, and even how far away the animal making the noise is.

Worldwide

1996.41.3634

Touch

Touch is a key sense for us in the dark and we often use it instinctively – entering a dark room, we reach out, feeling for the light switch. Like us, many nocturnal animals also rely on their sense of touch in the dark, supplementing their vision or hearing with what they can feel around them to help them to move through the night with ease.

Highly sensitive whiskers and bristles pick up tiny movements in the air, enabling animals to catch a passing insect or sense a predator nearby. Other creatures have particularly unique adaptations, such as the star-nosed mole, which uses its nose to feel for food in dark, underground burrows.

1. Star-nosed mole

Condylura cristata

Can you see this mole's unusual star-shaped nose? It has 22 feelers covered in thousands of sensors. By pressing its nose against the soil, the mole feels for earthworms and builds a picture of its surroundings.

North America

5.7.15.3

2. Tawny frogmouth

Podargus strigoides

Look closely at the bristles around the frogmouth's unusual beak. It is thought that these tiny bristles help it to feel the movement of air created by the wings of flying insects – its favourite food.

Australia

2014.73.41

3. Hazel dormouse

Muscardinus avellanarius

Dormice twitch and scoop their whiskers in a unique movement known as whisking. They use their whiskers to sense their surroundings and to judge distances, helping them to find food and scamper through the trees at night.

Europe

39.3703

Smell

From the sweet fragrance of nectar to the musky scent of pheromones (*feh-roe-mones*), the night air is filled with smells. In the pursuit of a tasty meal, nocturnal animals use their noses to smell food deep in the soil or to sniff out an individual tree within a forest.

The noses of these nocturnal creatures have adapted to detect particles in the night air over huge distances, enabling them not only to track down food but to smell each other. But it is not just noses that are used for smelling. Insects use their antennae to detect chemical perfumes released by the opposite sex.

European badger

Meles meles

Look at this badger's large claws. They are perfect for digging worms out of the soil. A single badger can eat hundreds of earthworms a night. It uses its excellent sense of smell to locate where the most earthworms are in the soil.

Europe

AQ-PEG-2018-2-LER

Please touch

What's that smell?

These smells are all scents that nocturnal animals might be searching for in the dark.

Take a sniff and see if you can guess what they are.

1. Pale-throated sloth

Bradypus tridactylus

Sloths are active at night, as well as during the day. Moving from branch to branch, they use their sense of smell to detect living branches containing sap so they can avoid dead branches that might break.

Brazil and Venezuela

81.2678

2. Large flying fox

Pteropus vampyrus

The largest bat in the world, the flying fox, uses its nose to sniff out nectar and fruit in the dark. At night it searches for its favourite foods – mangos, bananas and the flowers of coconut trees – in the forest.

Malaysia, the Philippines and Indonesia

9.1.5.49

3. Little spotted kiwi

Apteryx owenii

Can you spot this kiwi's nostrils? Unusually for a bird, they are at the tip of the beak. The kiwi pokes its nostrils into the leaf litter and down into the soil to sniff out insects and earthworms. The flightless kiwi is vulnerable to predators, so forages at night to avoid being seen.

New Zealand
NHMUK 1939.12.9.1437

4. Koala

Phascolarctos cinereus

Koalas spend most of the day asleep, usually waking at night to feed. Eucalyptus leaves make up 95% of their diet. Most koalas have a favourite eucalyptus tree that they eat from, which they are able to sniff out amongst the others in the forest.

Australia

96.1.28.1

Scent of attraction

Night-flying moths use scent to communicate and to find each other in the dark. They produce natural chemical perfumes called pheromones (*feh-roe-mones*). These drift through the night air signalling to other moths and attracting potential mates.

The feathery, supersized antennae of many male moths have thousands of tiny sensory hairs that help to sense a female's pheromones.

Some male moths have bristles called hair pencils under their wings that help to fan and disperse the pheromones they make in the glands beneath the bristles.

1–2. Male and female anchemola sphinx moths

Eumorpha anchemolus

The male anchemola (*an-cha-mole-ah*) sphinx moth produces a lemony scented pheromone (*feh-roe-mone*) to signal to females that it is the same species and is ready to mate.

Central America and South America

NHMUK010891878–79

3–4. Male and female atlas moths

Attacus atlas

Female atlas moths produce a scent to attract males to mate with. Sometimes the scent is so strong that male moths gather around a female's cocoon before she has even hatched. Astonishingly, some moths can smell each other from up to 10 kilometres away.

Southeast Asia
NHMUK010588345–46

Staying safe in the day

The arrival of the morning Sun poses a challenge for many nocturnal animals. After a busy night many need to find a safe place to rest, hiding inside dens or burrows until the darkness returns. Others have evolved camouflage so that they can hide in plain sight from day-time predators.

Some nocturnal animals even have adaptions that protect their eyes from the strength of the Sun's rays, so they can keep an eye out for predators or continue feeding during the day.

Camouflaged birds

These three nocturnal birds come from different parts of the world, but all look very similar. Their feathers provide camouflage to keep them hidden from day-time predators. During the day the potoo and frogmouth sleep in trees while the nightjar rests on the forest floor.

1. Tawny frogmouth
Podargus strigoides
Australia
1996.41.1262

2. European nightjar
Caprimulgus europaeus
Europe to eastern Asia
2014.73.51

3. Common potoo
Nyctibius griseus
Northern South America
1996.41.1260

Camouflaged moths

It isn't just nocturnal birds that blend into the background to stay safe during the day. Imagine you're in a forest, would you be able to spot these moths sitting completely still among the leaves?

4. Phylloxiphia sphinx moth
Phylloxiphia oberthueri
West Africa
NHMUK010891882

5. Verdant hawk moth
Euchloron megaera
Africa and Madagascar
NHMUK010891884

Red fox

Vulpes vulpes

Foxes sleep for around nine hours each day, so a safe place to rest during daylight hours is essential. They dig dens with underground tunnels that can be up to 22 metres in length, or curl up beneath hedgerows or behind buildings.

North America, Europe, Australia and parts of Asia

AQ-PEG-2018-5-LER

Please touch

6. White-lined gecko

Gekko vittatus

This gecko's large eyes are highly sensitive and detect colour, helping it to see more clearly at night. During the day it shrinks its pupils to wavy slits so it can keep watch for predators while protecting its eyes from the sunlight.

Indonesia
1998.249

7. Hummingbird hawkmoth

Macroglossum stellatarum

The eyes of the hummingbird hawkmoth contain a special pigment that enables it to feed during the day and night. In the day the pigment moves down to cover the eyes, shading them from the bright light of the Sun.

Europe, North Africa and Asia
NHMUK010588344

Night life

So why are some animals nocturnal? For most of us the night-time is for sleeping, but that's not the case in the animal kingdom. For many animals the night is not only full of opportunities but also a way to avoid the perils of day-time living.

For some it's a way to hide from predators, for others it's an opportunity to hunt, while for those living in deserts it means they can avoid the heat of the scorching Sun. But with increasing night-time human activity, the night is becoming lighter and noisier than ever before, impacting the lives of nocturnal animals around the world.

1. Fennec fox

Vulpes zerda

Like many nocturnal desert animals, the fennec fox forages and hunts at night to avoid the intense heat of the Sun. Its extra-large ear bones allow it to hear burrowing insects and small mammals moving around in the dark.

North Africa

72.161

2. Eastern spiny mouse

Acomys dimidiatus

Look at the eastern spiny mouse's pale coat. It blends in well with the sand at night, disguising the mouse from predators as it forages for seeds, insects and grasses to eat.

The Middle East

39.3978

3. Dung beetle

Scarabaeus satyrus

These beetles scavenge dung, roll it into a ball and then bury it as food for their young. To navigate in a straight line and escape from their competitors as quickly as possible, dung beetles follow the faint path of light of the Milky Way in the sky above.

Africa

NHMUK012848632

4–5. Giant anteater and mixed ants

Myrmecophaga tridactyla and Formicidae

The giant anteater's good sense of smell means it can forage for ants at night as well as during the day. Anteaters sometimes eat after dark to avoid the heat of the Sun, but might also be feeding during the night-time near towns in order to avoid people.

Northern South America

1975.1394, BMNH(E)2007–65

6. Eurasian stone curlew

Burhinus oedicnemus

While most other birds are sleeping, the stone curlew is feasting on the many insects, slugs and worms that come out at night. Can you see its large eyes? These help the curlew to find its dinner in the dark.

North Africa, Europe and Asia
1996.41.3600

7. Earthworm

Lumbricus terrestris

This species of common earthworm is the biggest in the UK, growing up to 40 centimetres in length. Worms burrow deep into the soil during the day, coming to the surface to feed at night when they won't dry out in the Sun.

Europe
2008.641–642

8–9. Beetles

Both of these beetles have adapted to protect themselves from the heat of the Sun. The day-active beetle's metallic colour reflects sunlight, keeping it cool. Whereas the nocturnal beetle comes out at night to avoid the Sun altogether – being black helps to camouflage it from predators.

8. Nocturnal carabidae beetle
Carabus coriaceus
Europe
NHMUK010842814

9. Day-active carabidae beetle
Carabus lafossei
Europe
NHMUK012848633

10. Manx shearwater

Puffinus puffinus

While Manx shearwaters are well adapted to life at sea, they are very clumsy on land, making them easy targets for large gulls waiting on the shore. To avoid being attacked, they return to their burrows to feed their chicks only under the cover of darkness.

Atlantic Ocean and Skomer in Wales
1996.41.3529

An illuminating issue

Human-made light pollution at night is increasing by 2% globally each year. As a result our nights are not as dark as they used to be. This increase in nocturnal light is changing the way both day-time and night-time animals around the world hunt, feed, mate, stay safe and interact with each other.

Some day-time animals have started to take advantage of the extra light to hunt and forage at night, whereas many nocturnal animals, which depend on the darkness to survive, are beginning to struggle as light levels increase.

1. Peregrine falcon

Falco peregrinus

The peregrine falcon usually hunts during the day, but due to the increases in night-time urban light in some cities it has been able to start hunting at night. This is bad news for nocturnal birds that now have a new predator to deal with.

Worldwide

1996.41.287

2. Boat-billed heron

Cochlearius cochlearius

Scientists don't know why these nocturnal herons never fish when there is lots of light around. Both moonlight and human-made light disturbs them. Increases in night-time light pollution could mean that these herons will struggle to feed.

Central America and northern South America

1996.41.51

Echolocation

It is a common misconception that bats have bad eyesight – most of the 1,116 species of bat that exist worldwide actually see well in the dark. Despite having good night vision, most bats often use echolocation and other senses to find food, such as moths, and to navigate at night.

Bats make a range of clicks and squeaks too high pitched for us to hear. These clicks bounce off trees, insects and animals and return like echoes, helping the bat to work out what and where something is in the dark. But not all bats have it their own way – some of the moths that they prey on have evolved to fight back in order to avoid becoming dinner.

1. Common pipistrelle

Pipistrellus pipistrellus

These bats use echolocation to catch moths and midges as they fly across wide open spaces such as parks and gardens. However, on rainy nights they might go hungry – raindrops not only make flying difficult but also confuse their echolocation systems.

Europe, North Africa and southwest Asia

43.53

2. Greater horseshoe bat

Rhinolophus ferrumequinum

Unlike most species, horseshoe bats use their noses rather than their mouths to echolocate. The horseshoe-shaped folds of skin around their noses focus and sharpen the echolocation beams so the bats can hunt more accurately.

Europe, the Middle East, eastern China and Japan
66.4309

3. Pallid bat

Antrozous pallidus

Pallid bats use their large ears to listen out for prey such as scorpions, ground crickets and beetles. They usually forage on the ground, but can also use echolocation to catch a meal while in flight.

Western North America and Mexico

27.9.21.1

4. Brown long-eared bat

Plecotus auritus

Look at the size of this bat's ears. The ears of the brown long-eared bat are often the same size as the rest of its head – if not bigger. Although they can echolocate, these bats usually hunt just by listening for the sounds of flying moths.

Europe
1939.3692

5. Common vampire bat

Desmodus rotundus

Vampire bats feed on the blood of animals. They use echolocation and smell to find a meal. These bats use heat sensors in their noses to locate blood vessels underneath the skin and then bite in just the right place.

Central America and South America

1990.252

6. Greater long-nosed fruit bat

Macroglossus sobrinus

Scientists have recently discovered that some fruit bats can echolocate. Fruit bats produce clicking sounds when they flap their wings that help them to find their way in the dark as they sniff out fruit and nectar to feed on in the forest.

Southeast Asia
70.1454

7. Greater bulldog bat

Noctilio leporinus

Known as the fishing bat, the greater bulldog bat can detect the movement of jumping fish and the ripples of water they make using echolocation. They swoop down to catch fish out of the water with their long, sharp claws.

Central America and South America

2.3.5.1

8–9. Male and female luna moths

Actias luna

Look closely at the tails on the wings of these moths – can you see a twist in them? This delicate twist reflects sound in an unexpected direction so that an echolocating bat is unable to pinpoint the position of the moth.

North America

NHMUK010891885, NHMUK010891886

10–11. Tiger moth and myotis bat

Erebidae and *Myotis* sp

Some species of tiger moth have been observed ‘screaming’ at myotis bats to scare them away as they come in for the kill.

10. North America

7.7.7.1819

11. Worldwide

NHMUK0109144553

12–13. Tiger moth and big brown bat

Bertholdia triogona and *Eptesicus fuscus*

This species of tiger moth makes noises that block the echolocation of the big brown bat. The moment of confusion allows the moth to escape.

12. Southwest USA
NHMUK010914552

13. North America, Central America and the Caribbean
19.3.5.2

A screech in the dark

Although flying at night allows moths to avoid day-time predators such as birds, it does mean that they become tasty targets for bats. Over the 50 million years since bats first took to the night skies, an evolutionary arms race between them and moths has been waged. Moths have evolved a defence mechanism – noise.

Some moths are able to make a rapid series of clicking noises using a structure on the side of their bodies called a tymbal organ (*tim-bal or-gan*). When merged together these clicks sound like a screech. Producing this screech at the right moment can confuse a bat's echolocation signal or scare it away, providing the moth with an opportunity to escape.

A tiger moth's screech intercepting a bat's echolocation beam.

Bats versus moths

Listen to these sounds made by moths and bats, which have been modified so that you can hear them.

Museum researcher Ian Kitching explains how some moths have evolved to defend themselves against bats in this arms race between predator and prey.

Running time: approximately 1 minute

Warning: This experience contains flashing lights and flickering shadows

While these lights do not strobe, those sensitive to flashing lights might find this exhibit disturbing.

If you require assistance, please ask at the ticket desk at the entrance of the exhibition.

Life in caves

Leave the outside world behind and dare to enter the mouth of the cave.

Hiding in this rocky underworld, creatures lie in wait, listening for echoes and feeling for the tiniest of movements.

Deeper down life survives in an underground world of total darkness.

What will you discover?

Inside caves

From craggy ceilings to flooded caverns, caves can make a good home for all sorts of creatures. The temperature inside is stable and life here is sheltered from the weather outside. The dark, rocky crevices also offer plenty of places to hide from predators.

Animals here make the most of the food available – whether that's hunting other cave-dwellers or feeding on their poo. But caves can be challenging environments. Over time cave creatures have evolved to catch prey, avoid predators and find their way in the dark.

Smell the bat guano

It's not just the bats themselves that are food for cave creatures, their poo is too. Known as guano, mounds of bat droppings build up in caves providing a nutritious feast for the insects and other animals that live there.

Do you dare to smell the bat poo?

1. Herald moth

Scoliopteryx libatrix

To avoid freezing in the cold winter months the herald moth hibernates in caves. Hiding in cracks in the rock allows the moth to remain at a stable temperature in the sheltered cave environment.

Europe and North America

NHMUK0109144551

2. Cave swiftlet

Collocalia sp

These swiftlets nest inside caves at night because they offer safety from predators. Returning every evening, each swiftlet must echolocate to find its nest amongst the thousands or even millions of others inside the cave.

Malaysia
1996.41.2034

3. Wrinkle-lipped bats

Chaerephon plicatus

These bats must find a safe place to rest during the day, which is why they can be found roosting in caves in their millions. As soon as dusk arrives, they swarm out in huge clouds, taking to the night sky to hunt.

Southeast Asia

9.1.5.509, 70.36.11.20, 70.1491

4. Giant centipede

Scolopendra gigantea

These giant centipedes aren't interested in eating the cockroaches scurrying around the cave floor. They're after something bigger – bats. Hanging from the cave walls they pounce on passing bats, injecting them with venom before devouring them.

Venezuela
1919.3.21.1

5–6. Giant cave cockroach and bat guano

Blaberus giganteus

If you go into a cave in Central America, you will likely see huge mounds of guano (bat poo) covered with feasting cockroaches. The flat body shape of the giant cave cockroach means that it can squeeze into nooks and crannies to hide from predators.

Central America and northern South America
NHMUK010926254

An unexpected find

Crocodiles don't just live in rivers and swamps. In Gabon, a population of African dwarf crocodiles has been found living inside a cave system. They are the only crocodiles in the world known to spend most of their lives in caves – the females only leave to lay their eggs and nest in the surrounding forest.

Scientists think this small population of dwarf crocodiles entered the caves 3,000 years ago. The bat-filled tunnels keep them well fed and provide shelter but with an unexpected consequence – the chemistry of the guano (bat poo) that accumulates inside the caves turns their scales orange.

Juvenile and adult African dwarf crocodiles
Osteolaemus tetraspis

Scientists recently discovered that the DNA of the cave-dwelling dwarf crocodiles is different to that of the crocodiles living in the surrounding forest – one day they might become a new species.

Abanda cave system, Gabon
1979.1, 1940.2.23.2

Seeing in the dark

How do you find your dinner in the dark? Some snakes hunt by sensing the body heat of their prey. When we lose heat from our bodies we are actually emitting infra-red. Snakes have special detectors called pit organs that allow them to see infra-red light. So although the snake cannot see the bat in detail in the dark, it can see its outline from the heat it is giving off and go in for the kill.

Pit organ

Nerves connecting the membrane to the part of the brain that processes sight.

Heat-sensitive pit membrane containing thousands of sensors that detect infra-red.

Puerto Rican cave boa
Chilabothrus inornatus

Imagine climbing into a cave, looking up and seeing the ceiling covered with snakes! These boas hang from the cave roof to catch bats as they fly in and out. Once a boa has caught a bat it will squeeze it to death.

Puerto Rico
1920.1.20.1627

Cave diving

Beyond the cave mouth, dark passages extend for many kilometres into the Earth. What could possibly survive down here? There's only one way to find out and that's to go cave diving, but this can be risky and, in some cases, even deadly.

These deep chambers are dangerous places for us – the air trapped inside can be toxic, their passages are often flooded and it is pitch black. Divers need specialist equipment to be able to see, breathe, map their routes and collect and document their discoveries. They bring back what they find for scientists to study. Around 90% of the world's caves remain unexplored and new species continue to be discovered.

1. Dive computer

Dive computers track how much time a diver has remaining to dive safely and tells them what depth and pressure they are at. This helps divers to avoid decompression sickness, which occurs when divers come up to the surface too quickly.

2. Mask

Divers wear masks to protect their eyes so that they can see underwater, but even so visibility in these flooded cave systems can be a problem. Maintaining a sky diving position helps divers to avoid disturbing sediment, which once in the water can reduce visibility to zero.

3. Light and headlamp

Imagine you are deep within a maze of underground tunnels and your only light goes out, leaving you in the pitch black. If this were to happen it would be very unlikely that you would find your way out. This is why cave divers always carry at least two backup lights and headlamps.

4. Dry suit

Water removes heat from our bodies faster than air, which means we become cold very quickly in water. Dry suits provide insulation, making them essential for most cave dives, especially in the cold conditions of the UK.

5. Rebreather

Cave divers usually carry at least two cylinders of gas for breathing but often use rebreathers for longer, deeper dives. Rebreathers filter and recycle the gas so the diver can reuse it, enabling them to stay underwater for longer. Carrying a backup gas cylinder is essential in case the rebreather breaks down.

6. Cave line and markers

When divers explore a new cave they lay a line to mark the route for themselves and for future divers, using markers to show information such as the direction of the exit. Subsequent dive teams might then lay extra lines to mark the entrance or when entering unexplored side passages.

7. Scientific equipment

Carrying out scientific research in caves requires divers to have dive skills, as well as the expertise and knowledge needed to survey, record and sample what they find. Divers fill sample pots and tubes with cave water before descending to prevent these from being crushed under the pressure of the water.

8. Fins

Cave divers use shorter, less flexible fins than those used in other types of diving. These fins allow divers to perform precision swimming techniques, such as frog kicking and finning backwards, which are necessary for squeezing through small gaps in the rock.

Into darkness

Journey through the underground world of flooded marine caves with experienced cave divers and scientists. Hear what it's like to explore these environments and discover the animals that live in total darkness.

Running time: approximately 6 minutes

Deep caves

Trapped deep down in flooded cave systems, cut off from the outside world and with only a limited supply of food, you might think that life would be struggling to survive. But over millions of years animals have evolved that can make the most of these dark places. Creatures down here wait patiently to catch fellow cave residents as they swim by or gather microscopic food particles floating in the water that fills these underground labyrinths.

Having evolved in total darkness most of these animals have no eyes and no colour – what use would these be anyway in the pitch black? These unusual, and often tiny, animals are incredibly well adapted to life in the darkest habitat on Earth.

1. Galatheid crab

Munidopsis polymorpha

Found only in the flooded marine caves of the Canary Islands, this blind, white crab uses touch and smell to find food carried in by the sea. Its closest relatives live in the dark ocean depths.

Jameos del Agua cave system, Lanzarote, Canary Islands
1993.72.6

2. Cave shrimp

Rhipidogammarus sp

This recently discovered shrimp was collected from deep beneath the Rock of Gibraltar. The shrimp sweep tiny bits of food into their mouths using their brush-like legs.

Ragged Staff Cave, Gibraltar
AQ-ZOO-2018-57

3. Remipede

Xibalbanus tulumensis

Discovered in 1981, remipedes (*reh-meh-peeds*) are the only venomous crustaceans in the world. Using their antennae they detect the movements and chemicals produced by shrimp and then immobilise them with venom.

Cenote Crustacea, Yucatán Peninsula, Mexico
AQ-ZOO-2018-58

4. Hot spring shrimp

Thermosbaena mirabilis

In Tunisia tiny shrimp have been found living in underground hot springs – surviving in total darkness and water as hot as 45°C. They use their long antennae to find their way around and their mouthparts to collect bacteria to eat.

Tunisia
1924.5.30.23

5–8. Copepods

Bomburiella giga, *Bifuriella vorata*,
Gloinella yagerae and *Oinella longiseta*

These tiny crustaceans are related to shrimp. The males detect the pheromone (*feh-roe-mone*) trails left by females in the water. They are named after the Viking saga *The Edda*, which gave JRR Tolkien the inspiration for his dwarves in his book *The Hobbit*.

The Caribbean
1998.2246-2247, 1998.2244, 1998.2767-2768, 1998.2771-2772

Galatheid crab

Munidopsis polymorpha

Please touch

Mexican blind cave fish

Mexican tetra fish living in rivers above ground became trapped and isolated in an underground system of lakes when water levels dropped. Over time they evolved into the subspecies of Mexican blind cave fish on display here. In the total darkness of these caves they became blind and colourless. They are extremely sensitive to pressure and vibration and have an acute sense of smell to compensate for their lack of vision.

Their bodies are covered in sensory hair cells called neuromasts (*nure-row-masts*) that respond to vibrations in the water. They will swim towards any vibration they feel.

Chemosensors (*kee-moe-sen-sors*) around their mouths detect particles of food, such as guano (bat poo), in the water that flows through the caves.

Mexican blind cave fish
Astyanax mexicanus

As there is no night or day inside the cave, the body clocks of Mexican blind cave fish are constantly 'awake', which means they are always active. Compared to their surface-dwelling relatives they behave unusually. They swim constantly, don't sleep and are very solitary, never shoaling together.

Texas and New Mexico, USA, and Mexico

Please do not bang on the glass, as this upsets the fish.

Super senses

Animals living in the extreme environments inside caves have evolved amazing senses that mean they are able to reproduce, find a tasty meal and avoid being eaten in the dark. Some have chemosensors (*kee-moe-sen-sors*) that work like taste and smell, enabling them to detect microscopic bits of food in the water.

Others have antennae and modified legs covered with mechanosensors (*meh-kan-oh-sen-sors*) that help them to sense the presence of other animals by picking up movements or changes in pressure. One unusual species has even evolved the ability to find its prey by sensing its electric field – known as electrosensing (*eh-lek-tro-sen-sing*).

1. Olm

Proteus anguinus

Unlike most amphibians, these salamanders eat, sleep and breed in water. Sensing the electric fields of objects in their environment helps them detect tasty snails and other olms in the dark. In the past, people used to think olms were baby dragons.

Dinaric Alps, south eastern Europe
IM515

2. Remipede

Xibalbanus tulumensis

Can you imagine tasting with your hair? This is what the remipede (*reh-meh-peed*) does – it has no eyes and instead relies on the chemosensors (*kee-moe-sen-sors*) covering the fringe of sensory hairs on its head and antennae. These act like taste buds, enabling it to find food in the water.

Cenote Crustacea, Yucatán Peninsula, Mexico
AQ-ZOO-2018-58

Remipede
Xibalbanus tulumensis

Please touch

3. Whip spider

Euphrynichus bacillifer

Look how long this whip spider's first pair of legs is. Lying in wait, it uses these like antennae to sense the surrounding environment. These legs are covered in mechanosensors (*meh-kan-oh-sen-sors*) that pick up movements in the air, alerting the whip spider to the presence of a potential meal.

Mozambique

BM 1913.5.20.1

4. New Zealand cave wētā

Pachyrhamma waitomoensis

These giant cave crickets have antennae five times longer than their bodies that they use to feel the motion of nearby predators. Their long legs enable them to quickly escape predators and run across the surface of any streams blocking their way.

New Zealand

NHMUK011251995, NHMUK011252002

Electrosensing

In caves, olms are the top predators.

Move your hand slowly towards the olm and see how hard it is to get close without it sensing you.

You've been eaten!

Olms sense the electric fields of animals around them to help locate food, usually small snails.

Life in the deep

Dive beneath the waves and sink down to the depths of the ocean.

Down here tentacled creatures drift in the dark, fish scavenge for food and mysterious lights flash in the distance.

Even in this vast watery realm where sunlight never reaches, life still flourishes.

Who will you encounter?

Welcome aboard!

Explore the deep sea with scientists from the *Nautilus*. This research ship has two remotely operated vehicles (ROVs) that travel down to a depth of 4,000 metres.

Scientists control these ROVs from the surface to film the animals that live down in the depths of the ocean, as well as to collect samples and to explore these unknown places.

Watch these expeditions live at **nautiluslive.org**.

Nautilus glossary

***Argus*:** an ROV
Bridge: the person steering the ship
Exploration vessel (E/V) *Nautilus*: the ship where the team live and work
***Hercules*:** an ROV, also called Herc for short
Pilot: the person steering the ROV

Footage courtesy of the Ocean Exploration Trust/ Nautilis Live.

In the deep

The ocean is the largest habitat on Earth – and most of it is dark. Beyond a depth of 1,000 metres sunlight disappears and darkness, crushing pressure and low temperatures become the norm. But even in these extreme conditions there is life. Down here animals scavenge for food and hunt prey in the sediment of the seafloor and in the open ocean.

In areas of volcanic activity, hydrothermal vents occur, churning out chemical-rich liquid that provides energy for a whole host of deep-sea creatures. Only around 5% of the ocean has been explored, so there is still much to be discovered. What do you think might be out there?

1. Sea spider

Decolopoda australis

There's not much food in the darkness underneath the Antarctic ice, but these sea spiders can still grow up to 76 centimetres from claw to claw. They travel across the seafloor looking for slow-moving or stationary animals, such as sponges, to eat.

Antarctica | Depth: 50–1,900 metres
1933.3.23.10

2. Dumbo octopus

Cirroteuthis sp

One of the largest animals in the deep sea, the Dumbo octopus can grow up to 1.5 metres in length. As it swims along, its large fins look like ears, earning it the name Dumbo.

North Atlantic Ocean and North Pacific Ocean
Depth: 700–5,000 metres
20150221

3. Sea cucumber

Oneirophanta mutabilis

With peg-like feet and sensory tentacles, sea cucumbers crawl along the seafloor sucking up anything edible they find. They are one of the most common animals on the abyssal plains – the vast stretches of sediment kilometres below the surface of the ocean.

Worldwide
Depth: 2,500–6,000 metres
1883.6.18.33

4. Giant isopod

Bathynomus giganteus

The giant isopod (*eye-so-pod*) is an ocean-dwelling relative of the woodlouse with large, reflective eyes. As a scavenger it eats anything it comes across on the seafloor, from dead seals to sea cucumbers.

Atlantic Ocean
Depth: 310–2,140 metres
IM169

5. Pelican eel

Eurypharynx pelecanoides

The black, scale-less skin of these eels makes them almost invisible in the darkness. They dangle tiny lights from the end of their tails, which they curve round near to their mouths, to attract small animals. When their prey gets close enough, they open their enormous mouths and engulf it.

Worldwide
Depth: 500–7,600 metres
2003.1.16.2

6. Scale worm

Eulagisca gigantea

Look out for this scale worm's terrifying teeth. The scientists who collected it nicknamed it Jaws. Using its shimmering golden bristles, it swims or crawls across the seafloor, shooting out its teeth to bite unsuspecting prey.

Antarctica
Depth: 520–670 metres
2018.25353

7. Pompeii worm

Alvinella pompejana

Imagine having your head in the fridge and your feet in the oven. Pompeii worms live with their tails attached to the vent surrounded by water as hot as 80°C and their heads surrounded by water that is a cooler 22°C. Scientists don't know how they survive in this heat.

Pacific Ocean
Depth: 2,500–2,700 metres
Z8 1980:7

8. Blind vent shrimp

Rimicaris kairei

Instead of eyes, these shrimp have an area on their backs that contains rhodopsin (*roh-dop-sin*) – the pigment we use to see in low light. This allows them to sense and avoid the hottest areas of the vent while feeding on the bacteria that live there.

Indian Ocean
Depth: 2,400–3,300 metres
On loan courtesy of Senckenberg am Meer (DZMB) – Federal Institute for Geosciences and Natural Resources.

9. Blind vent crab

Bythograea thermydron

Despite what their name suggests blind vent crabs aren't actually blind – they just see differently. Instead of eyes they have naked retinas that enable them to see infra-red light. This means they can see hydrothermal vents by the heat they give off.

East Pacific Rise vent systems in the Pacific Ocean
Depth: 2,500 metres
1981.629

10. Giant tube worm

Riftia pachyptila

These giant tube worms grow to a height of one to two metres – that's as tall as a person! They absorb oxygen and hydrogen sulphide through their bright red feathery tendrils. Colonies of bacteria living inside the worms turn these chemicals into energy for the worms to use.

East Pacific Rise in the Pacific Ocean
Depth: 1,800–3,050 metres
2013.25

Hydrothermal vents

Across the cold expanse of the seabed, small pockets of abundant life can be found thriving around hydrothermal vents. These chimneys spew out sulphurous liquids often hotter than 400°C from deep beneath the Earth's crust. The vents produce chemicals that provide a source of energy for a host of microbes that in turn provide food for the whole ecosystem, from tube worms and shrimp to crabs and sharks.

Blind vent shrimp, *Rimicaris kairei*

Spots of pigment on their backs sense heat of the vents.

Giant tube worms, *Riftia pachyptila*

Red feathery gills absorb nutrients from the vents.

Sea of senses

In water, the deeper you go, the darker it gets. By the time you reach a depth of 1,000 metres all sunlight has been absorbed – everything living deeper than this has to be able to survive in near darkness. Like those in caves, animals in the deep sea have evolved enhanced senses that enable them to find food, search for mates and avoid predators.

Some animals use chemosensors (*kee-moe-sen-sors*) to detect the scent of a rotting whale carcass from miles away from the tiny particles that drift in the current. Others use mechanosensors (*meh-kan-oh-sen-sors*) to sense the movements in the water created by animals swimming by, enabling them to detect the presence of predators and prey.

1. Sixgill hagfish

Eptatretus hexatrema

Hagfish have four sensitive tentacles around their mouths that detect particles of food from great distances. This means they are often the first on the scene to take advantage of a new food source, such as a whale carcass that has fallen to the seafloor.

Atlantic Ocean and Indian Ocean
Depth: 0–400 metres
1935.5.2.39–40

2. Rabbit fish

Chimaera monstrosa

Rabbitfish not only use smell to locate their prey they also use their lateral line system to sense it moving in the water. Look closely at this rabbitfish's head – can you see the dots and lines? This is the lateral line system.

Northeast Atlantic Ocean and
the Mediterranean Sea
Depth: 50–1,600 metres
1973.10.29.36

3. Male and female conjoined seadevil

Melanocetus johnsonii

It can be difficult to find a mate in the vast ocean. Female seadevils release pheromones (*feh-roe-mones*) to attract a mate. When a male finally finds a female he attaches himself to her and obtains all his nutrients from her. Can you spot the tiny male?

Worldwide
Depth: 100–4,500 metres
2004.6.3.2–3

5. Tripod fish

Bathypterois longipes

Could you stand on your tiptoes all day? Balancing on three elongated finrays, the tripod fish waits for the telltale movements of its prey. Two more long thin finrays over its head feel for currents in the water so that it can detect any small creatures that pass by.

North Atlantic
Depth: 2,600–5,500 metres
1994.9.20.2–3

6. Gulper shark

Centrophorus seychellorum

The gulper shark is perfectly adapted for life in the deep sea – it has lateral lines to sense prey moving and a type of fat called squalene that helps it use the limited oxygen available. Unfortunately, human demand for squalene means this slow-growing shark has been heavily overfished.

Worldwide
Depth: 50–1,200 metres
1973.7.9.12

7. Giant red shrimp

Neognathophausia ingens

This shrimp can grow up to 35 centimetres in length. Can you see its long antennae? They are covered with mechanosensors (*meh-kan-oh-sen-sors*) and chemosensors (*kee-moe-sen-sors*) for finding food. In life this shrimp is dark red, making it hard to spot, as red light is absorbed quickly in the deep sea.

Worldwide
Depth: 250–4,000 metres
1927.4.21.1

Ocean lights

Unlike many cave creatures, most animals in the deep sea still have eyes, but if there's no sunlight down there then why do they need them?
In the deep sea an astonishing 90% of animals make their own light, a phenomenon known as bioluminescence (*bye-o-loo-min-s-sense*). Through the gloom patterns of blue light twinkle, green mucus glows and red lights flash in the distance.

Deep-sea creatures use light not only to illuminate or stun prey but also to communicate with each other. Glowing lights camouflage while a flash of light can scare away a predator or create a distraction. In the dark depths, producing light is a key survival strategy. Enter the beautiful world of bioluminescence.

Lights in the deep

If you were in the deep sea, looking through your submersible, you might see the odd flash of colour in the waters, but through the sensitive eyes of deep-sea fish, fireworks can appear.

The installation of more than 1,500 individual LEDs awaiting you, mimics the bioluminescence light shows that occur in the ocean. It has been produced in collaboration with deep-sea researchers.

1. Atlantic football fish

Himantolophus groenlandicus

The football fish moves its flashing bioluminescent lure around above its head to attract unsuspecting prey towards it in the dark. This species was discovered in 1837 and was the first deep-sea anglerfish ever to be described.

Worldwide
Depth: 300–3,000 metres
2018.4.27.1

2. Sloane's viperfish

Chauliodus sloani

Light organs on its belly camouflage the viperfish, while a light on the end of its long dorsal fin lures prey close enough to be attacked. The viperfish has the biggest teeth relative to the size of its body of any fish in the sea.

Worldwide
Depth: 200–2,000 metres
2004.3.19.97

3. Cookie cutter shark

Isistius brasiliensis

Scientists think the bioluminescent pattern on this shark's belly helps to make the dark patch on its neck look like a smaller fish to those below. Fish approach the shark in pursuit of an easy catch, but once they're within striking distance the cookie cutter shark, living up to its name, takes a circular chunk out of them.

Atlantic Ocean, Pacific Ocean and Indian Ocean
Depth: 0–3,500 metres
1996.7.10:29

Finding food

Without light from the Sun to provide energy, food is limited in the dark depths of the ocean. Many deep-sea animals are scavengers, surviving off small bits of decaying plants and animals that drift down from above – known as marine snow. But there are also predators in the depths. They use light to help capture their prey.

Some use glowing light to lure unsuspecting animals towards their jaws, others use it to disguise themselves or to mask the shape of their bodies. Swim towards an innocent-looking light in the deep sea and it might be the last thing you do.

Atlantic football fish
Himantolophus groenlandicus

Siphonophore model

Siphonophores (*sigh-fon-oh-fores*) are among the strangest organisms living in the ocean. Some of these patient predators produce flashes of light that mimic shoals of small fish or copepods (*ko-peh-pods*). When an animal comes to investigate the siphonophore envelops it in a tangle of stinging tentacles.

AQ-PEG-2018-11-LER

Stoplight loosejaw
Malacosteus niger

Stoplight loosejaws have an advantage – they can see red light in the ocean, which is invisible to most deep sea life. They have red bioluminescent headlights, as well as blue photophores (*fo-toe-fors*), so they can look for food and find a mate without being seen themselves.

Worldwide
Depth: 500–4,000 metres
2003.1.13.55

Communicating

In thousands of miles of dark open ocean how do you find each other? Some animals produce glowing patterns of light to recognise one another and to signal to potential mates. But making yourself too obvious comes with a risk – your date might become someone else's dinner.

A few species use yellow or red light because most deep-sea creatures can't see these colours, allowing them to attract a mate without drawing attention to themselves.

Stoplight loosejaw
Malacosteus niger

1. Bearded seadevil

Linophryne coronata

The bearded seadevil is particularly unusual in that it has two glowing lures. One hangs from above and the other, called a barbel, grows from its chin. Scientists think these lights help to signal their presence to potential mates as well as lure prey.

Atlantic Ocean and North Pacific Ocean
Depth: 0–1,500 metres
1996.1.25.1

2. Japetella

Japetella diaphana

This tiny female octopus produces a ring of yellow light around its mouth to attract a mate. They can quickly turn their see-through bodies dark red by using the colour organs in their skin, helping them to hide from the bioluminescent searchlights of predators.

Tropical and subtropical waters worldwide
Depth: 200–1,000 metres
20170380

3–4. Female and male threadfin dragonfish

Echiostoma barbatum

Dragonfish are fast-moving, aggressive hunters that use glowing lures not only to attract food but also to find a mate in the dark. Can you see the spots behind their eyes? Scientists think the shape of these lights help the male and female to recognise each other.

Worldwide
Depth: 30–2,000 metres
1991.12.16.5, 1988.2.25.36

Atolla jellyfish
Atolla wyvillei

The Atolla jellyfish uses bioluminescence like a burglar alarm. When threatened, the jellyfish makes swirling patterns of light, which attract predators, such as giant squid. These predators attack the jellyfish's attacker, allowing the jellyfish to swim away unharmed.

Worldwide
Depth: 0–5,200 metres
AQ-PEG-2018-10-LER

Defence

It's a fish eat fish world in the open ocean. Over millions of years, animals have evolved numerous strategies to defend themselves, and using light can be one of the most spectacular there is. A sudden flash can startle or blind a predator, glowing lights can act as a distraction or a swirl of bright blue can be an alarm call. Under the cover of light an animal can escape and swim safely away, retreating back into the dark.

The Atolla jellyfish uses a catherine wheel of lights as a burglar alarm.

Sea lilies anchored to the seafloor flash to deter other animals from settling on them.

Shrimp can spit out bioluminescent gloop – predators follow this light and the shrimp escapes.

1. Brittle star

Ophiomusium lymani

Brittle stars have evolved a whole armoury of bioluminescent defensive tools. When approached some species flash brightly to temporarily blind predators. Others produce gently glowing, foul-tasting mucus to signal that they are toxic.

Atlantic Ocean and Indo-Pacific Ocean
Depth: 50–5,000 metres
1882.12.23.141

2. Sea lily

Neocrinus decorus

Although they look like plants, sea lilies are actually animals related to starfish. Some sea lilies create flashes of light that travel along their bodies to scare away anything that might eat them.

Caribbean Sea
Depth: 150–1,200 metres
1898.5.4.784

Vampire squid

Vampyroteuthis infernalis

The vampire squid is a master of defence. Flashing photophores (*fo-toe-fors*) at the tips of its arms confuse predators. It also curls its arms back over its head to transform itself into a spikey ball.
If all else fails, the squid ejects a thick cloud of glowing mucus to mask its get-away.

Worldwide
Depth: 600–1,200 metres, possibly deeper
20170381

Vampire squid models

1. Umbrella posture

The vampire squid uses its ear-like fins to swim through the water. It trails its two long feeding tentacles through the water to snag food.

2. Pineapple posture

When threatened, the vampire squid covers itself with the webbing between its arms, also known as its cloak, exposing its spikes.

Please touch.

Camouflage

Little sunlight reaches the twilight zone, 200–1,000 metres deep. Down here it's just bright enough for large-eyed creatures to spot the silhouette of a predator or prey against the background of light from the surface. So how do you stay hidden in the open ocean?

Camouflage is key to survival and surprisingly making light could actually help you hide. Many deep-sea creatures use bioluminescent organs called photophores (*fo-toe-fors*) to create patterns of light on their bodies. These patterns break up their outlines, making them harder to spot against the light from above. This counter-illumination helps them to hide in plain sight.

Velvet belly lanternshark, *Etmopterus spinax*

Krill, Euphausiids

Jewelled squid, *Histioteuthis bonnellii*

3. Velvet belly lanternshark

Etmopterus spinax

One of the smallest and most common sharks in the ocean, the velvet belly lanternshark has many predators. It disguises its silhouette with rows of photophores (*fo-toe-fors*) along its belly that match the light coming down through the water from above.

Atlantic Ocean and the Mediterranean Sea
Depth: 200–2,500 metres
1973.10.29:19–26

4. Spookfish

Opisthoproctus sp

The spookfish has huge oval eyes that point upwards, which detect the silhouettes of prey above. Mirror-like structures in its belly reflect the bioluminescence produced in its gut, camouflaging it from the sharp eyes of predators looking at it from below.

Worldwide
Depth: 300–4,000 metres
On loan courtesy of Discovery Collections,
National Oceanography Centre, Southampton.

5. Krill

Euphausiids

These small shrimp-like creatures are top of the menu for many predators. To avoid being eaten krill have bioluminescent bellies for camouflage. Some species of shrimp also use bioluminescence. They spit out glowing gloop when threatened – a bright smoke screen to hide their escape.

Worldwide
Depth: 0– 2,000 metres
AQ-ZOO-2018-59

6. Jewelled squid

Histioteuthis bonnellii

This squid is named after the jewel-like light organs that break up its silhouette, helping it to camouflage itself. It has one large, yellow eye that looks up to spot the silhouettes of prey above, and another eye that faces down to look for the blue flashes of bioluminescent life below.

Atlantic Ocean and southwest Pacific Ocean
Depth: 100–2,200 metres
20170382

Back to the surface

Each evening, as the Sun goes down, the greatest migration on the planet takes place as billions of deep-sea animals rise up from the watery depths to feed. In the well-lit surface waters microscopic plants called phytoplankton (*fie-toe-plank-ton*) get energy from the Sun. As darkness descends, tiny animals known as zooplankton (*zoo-plank-ton*) migrate up from the depths of the ocean to eat the phytoplankton.

Larger predators, such as fish and squid, follow to feed on the zooplankton. The feeding frenzy continues until dawn. But as soon as the Sun rises, these animals descend back to the relative safety of the darkness below.

Zooplankton
Copepod

Phytoplankton

Zooplankton
Hyperia sp

Lanternfish

Every night lanternfish make a kilometre round trip to feed. They swim up from the twilight zone at 500 metres below the waves to the shallower depth of 150 metres, where they feed on tiny zooplankton, copepods and small fish.

1. Barne's lanternfish
Gonichthys barnesi
1875.5.14.602–606

2. Barnard's lanternfish
Symbolophorus barnardi
1926.6.30.6–8

3. Cocco's lanternfish
Gonichthys cocco
2016.5.5.101–102

Worldwide
Depth: 0–1,500 metres

Zooplankton

An entire microscopic ecosystem floats in the ocean currents. Zooplankton (*zoo-plank-ton*) are tiny animals that eat even smaller plants. Many are transparent and so are almost invisible in the water. They sink down into the dark depths during the day, where they are even harder to spot.

Phytoplankton

Phytoplankton (*fie-toe-plank-ton*) are microscopic plants that live in the well-lit surface waters of the ocean and get energy from sunlight. They play an essential role in the ocean ecosystem and are the basis of most food chains in the oceans.

Step outside

All around the world life thrives in darkness.

Hidden in moonlit gardens, nestled in dark caves and glowing in the ocean depths, there is much to explore.

What could you discover?

Draw your discovery

Observing and drawing animals is an important part of studying them and of discovering new species.

If you were to discover a new species what would it be?

Take a card and draw a picture of either an animal you would like to discover or one of the animals on display.

A selection will be displayed here.

Explore more

At any one time, at least half of the world is in darkness, while sunlight never reaches underground caves or the deep sea. We are still discovering new species as we continue to explore and study the dark corners of our planet.

These specimens have all recently been discovered. Whenever scientists discover something they think is new they compare it to species already known to science. If it is a new species, they describe what makes it different and name it.

Finding out about the animals that live in the dark and how they survive there can teach us more about our world and help us to face the big challenges the future will bring.

1. Tube worms

Lamellibrachia sp nov

These tube worms were discovered in 2013 at a hydrothermal vent. When scientists from the Museum tested the DNA from these worms they found that they were an entirely new species.

Von Damm Vent Field, Cayman Trough, Caribbean Sea
2018.25372

2. Copepod

Ridgewayia sp nov

Scientists caught this tiny copepod in a plankton net when surveying Oven Rock Cave in the Bahamas. When studying the specimen under a microscope Museum researcher Geoff Boxshall noticed it had a variety of differences from other copepods in the same family and was in fact a new species.

Oven Rock Cave, Exuma Cays, Bahamas
NHMUK 2018.106

3. Parasitoid wasps

Netelia williamsi

Scientist Gavin Broad studies nocturnal parasitoid (*para-sit-oid*) wasps at the Museum. When he first collected this species in a moth trap in 2008, he thought it looked different. After comparing it to other specimens in the Museum's collection he discovered that it was a completely new species.

Aldbury, Hertfordshire, UK
010880515-6, 010880556-9, 010880562-6