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All about THE EYE

B4U PUBLISHING

All about THE EYE

SEA WASP

Chironex fleckeri

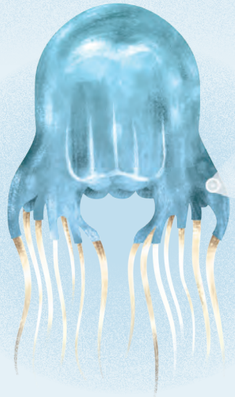
The faraway tropical waters are inhabited by an inconspicuous but deadly animal. What makes it even more dangerous is the fact it can be easily overlooked by an incautious swimmer: the body of up to 25 cm and the sixty stinging tentacles of up to three metres are semi-translucent. Beware of them as the venom of Chironex fleckeri, also known as the sea wasp, is one of the strongest venoms in the world. It can kill a man in only two minutes!

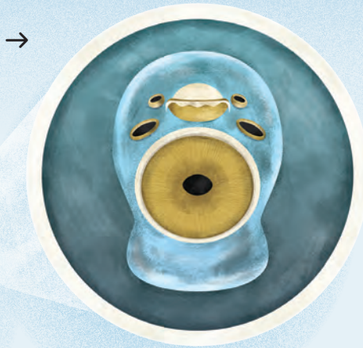
EXTREMELY POISONOUS TENTACLES ↓

Interesting

TWENTY FOUR EYES ALL OVER WHOLE BODY

RHOPALIUM →





↑

RHOPALIUM IS A CLUSTER OF SIX EYES

3 m

Cnidaria

Indian and Pacific Oceans, Australia

rhopalia

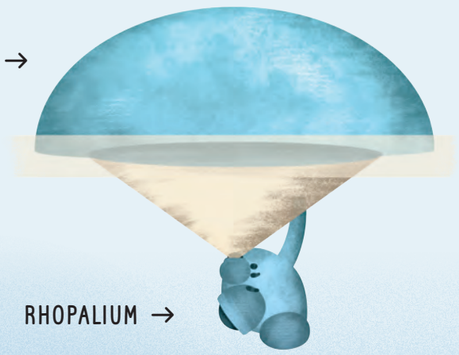
RHOPALIUM

Cnidarian eyes are arranged in a special sense organ called the rhopalium. The sea wasp has four rhopalia, and each of them is composed of a cluster of six eyes. Two of them have an extremely fine lens, as mentioned above. The remaining six eyes of each rhopalium are simple. As one can see, the sea wasp's visual skills are amazing! Jellyfish lack, however, one organ to achieve perfect image perception. Do you know which one? It is the brain. Although it is difficult to perceive images with a simple nervous system, nature dealt with this limitation as well. When a jellyfish needs to move towards food, it is the rhopalium that triggers the body contraction and subsequent movement.

SEEING ABOVE THE SURFACE

The sea wasp has a total of twenty-four different eyes on its body. Eight of them are outer eyes with a diameter of only a tenth of a millimetre and are similar to the perfect eyes of vertebrates: they consists of retina, lens, iris and cornea. Scientists have wondered for years how the perfect eyes of sea wasps evolved and what their purpose was. We know today that sea wasps use their vision to look for stilt mangrove roots, where they live in dry seasons. The roots are full of shellfish on which the sea wasp feeds in mangroves. The outer eyes help the sea wasp see the world above the surface in a relatively large visual field.

VISUAL FIELD → UP TO 100° ABOVE THE SURFACE



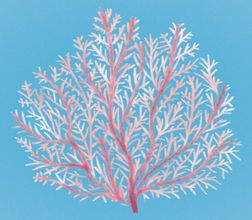
RHOPALIUM →

Stinging creatures

IN ADDITION TO JELLYFISH, THE CNIDARIA GROUP COMPRISES MANY STUNNING ANIMALS.

PORTUGUESE MAN O'WAR

RED CORAL

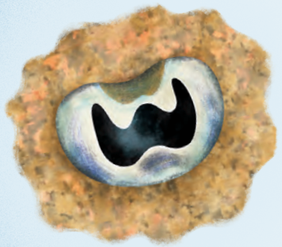


PURPLE SEA FAN

HYDRA VIRIDISSIMA

COMMON CUTTLEFISH

Sepia officinalis



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EYE ADAPTED TO SEE POLARIZED LIGHT

The cuttlefish lives on the seabed of the Mediterranean Sea and the eastern Atlantic. This cousin of the octopus ranks among the perfect sea predators! It hides in the sand during the day and becomes active when the evening begins: it waits at the sea bottom, looking for potential prey, which it then slowly approaches. Once the prey is within reach of the tentacles of the cuttlefish, two long arms with suckers spring up and grasp it in a flash. The strong beak-like jaws quickly kill the prey and the feast may begin.

45 cm

Cephalopoda

Mediterranean Sea, eastern Atlantic

it perceives polarized light

SECRET SIGNAL

Under its colour cells, the cuttlefish has a special "grid" reflecting polarized light. The reflected light is thus dispersed into the surrounding area and remains invisible to most animals. But it is perceived by the cuttlefish! The cuttlefish has highly-developed eyes similar to yours which are specially adapted to see polarized light. This secret signal helps them remain unseen by other animals and keep track of their relatives. Even when they are perfectly camouflaged. What if a larger predator encounters them by accident? The cuttlefish releases ink which briefly paralyses the enemy and disguises the cuttlefish.

Interesting

IT SPRAYS INK WHEN IN DANGER

UNSUSPECTING PREY ↓

HIDDEN CUTTLEFISH ↓

SEABED →

← HIGHLY DEVELOPED EYES

↑
COLOUR CHANGING SKIN

SEA CHAMELEON

One of the most important characteristics of a good predator is the ability to be inconspicuous. If the prey saw the hunter from afar, it would have plenty of time to flee to safety, and the hunter would go to bed on an empty stomach. The cuttlefish has developed an amazing camouflage tactic to confuse both potential food and larger predators. It can change not only its colour but also the pattern and structure of its body surface! It also has spots comprised of cells reflecting light on its body. They can shrink or enlarge and form an image similar to large eyes to discourage larger predators. There is a good reason for calling cuttlefish "sea chameleons"!

Disguised agents

THE ABILITY TO CHANGE THE COLOUR OF ITS BODY IS DUE TO THE PRESENCE OF SPECIAL CELLS CALLED CHROMATOPHORES.

COMMON OCTOPUS

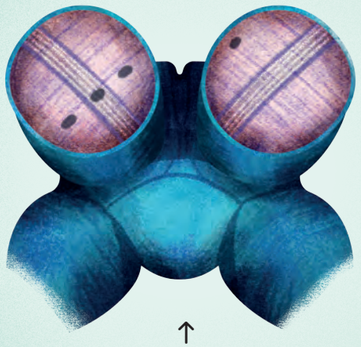
EUROPEAN TREE FROG

PANTHER CHAMELEON

PRAYING MANTIS

PEACOCK MANTIS SHRIMP

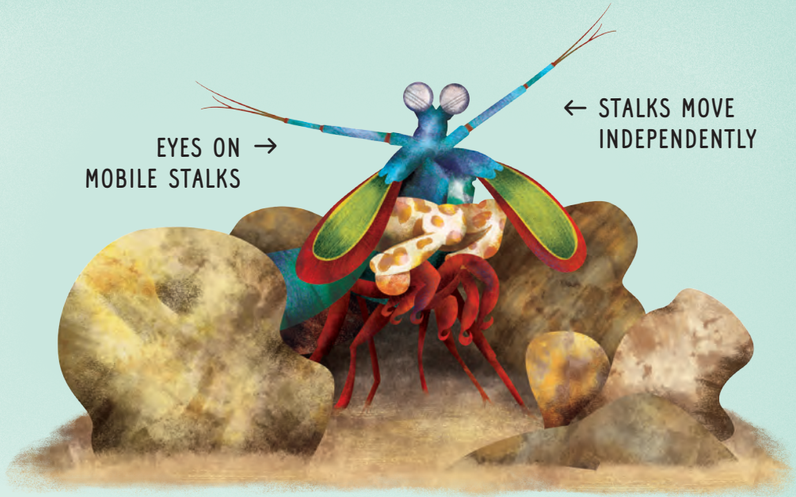
Odontodactylus scyllarus



↑
EYES WITH
12 PHOTORECEPTORS

Mantis shrimp has distinctive eyes mounted on mobile stalks, enabling it to cover a large visual field. They can even move independently of each other! Perfect spatial vision is essential to the mantis shrimp. Another interesting fact is the number of photosensitive cells in the mantis shrimp's eyes: while a man has three types of photoreceptors, the mantis shrimp has twelve of them! It can thus perceive ultraviolet and polarized light. Like cuttlefish, the mantis shrimp uses polarized light for intraspecies communication.

- up to 18 cm
- Crustacea
- Pacific and Indian Oceans
- most cell types in the eye



FAST CLAWS

Do you want to know what the mantis shrimp feeds on? Its prey consists mainly of various crustaceans, molluscs and small fish. The mantis shrimp first look around to find them and then hunts them out of their shelter with its massive claws. It hides in various rock structures on coral reefs or in tunnels it digs in the seafloor. When hunting, it takes advantage of its strength as well as its speed. During an attack, the claws move at 23 m/s! Their prey is stunned and killed in a flash.

PRAWN KILLER

Although it may not appear to be likely at first glance, mantis shrimp is one of the most savage sea predators. It has even been nicknamed "prawn killer" based on its ferocity and aggression. This crustacean with strong claws is up to 18 cm long, but despite its size, can be immensely strong! This ironside has the most powerful blow of all animals in the world. The mantis shrimp can even break the glass aquarium in which it is sometimes kept.

Beware

WHAT ANIMALS DO YOU THINK OF WHEN TALKING ABOUT THE MOST SAVAGE SEA PREDATORS?

LEOPARD SEAL

GREAT WHITE SHARK

SALTWATER CROCODILE

KILLER WHALE

FANGTOOTH MORAY

EUROPEAN PLAICE

Pleuronectes platessa

50 to 60 cm

Osteichthyes

Europe

the left eye moves to the right side

The sandy or muddy bottom of European seas often harbours one inconspicuous species of fish, the European plaice. Its disc-shaped body can be easily overlooked, which is to the benefit of the plaice. After all, it is not very fast or agile. The body of the plaice is flattened and coloured similarly to the seabed. In order to bring the camouflage to perfection, the plaice lies on one side and often burrows into the sand. Since an eye directed into the sand would be no use, the left eye shifts to the right side of the head next to the right eye when the plaice transforms into an adult. Moreover, its eyes bulge and can move independently of each other. The plaice thus remains unnoticed, while cautiously monitoring the environment.

Interesting

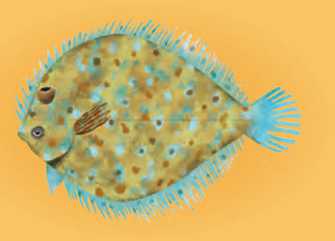
ALTHOUGH IT HAS ITS EYES ON ONE SIDE OF THE HEAD, ITS MOUTH FACES TO THE SIDE

EVOLUTION

How does the plaice develop over the course of its life? The plaice hatches from eggs into common fry with a bilaterally symmetrical body. The young plaice is buoyed by a swim bladder and floats freely. When the time comes to mature, it begins gradually leaning towards the seabed. The plaice progressively loses its swim bladder, until it completely lies on one side. Its diet also changes during development. While the food of larvae consists of plankton and larvae of other animals, the adult plaice feeds on various molluscs, sea worms, crustaceans and smaller fish. It hunts them with its mouth which, unlike the eyes, remains oriented to the side.

Flatfish

THE PLAICE IS NOT THE ONLY FLATFISH. A FLATTENED BODY WITH A SHIFTED EYE IS ALSO TYPICAL FOR FLOUNDERS, TURBOTS, COMMON SOLES AND OTHER SPECIES. ALL OF THESE ARE CLOSELY RELATED TO THE PLAICE.



LEOPARD FLOUNDER

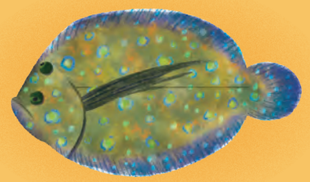
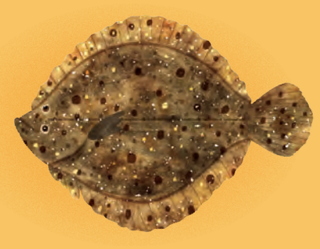


PLATE FISH



TURBOT

COMMON SOLE

GOLDEN EAGLE

Aquila chrysaetos

80 to 90 cm

Aves, Accipitriformes

North America, Europe, North Africa

excellent long-distance vision

Do you know what animal is referred to as the king of the birds? The majestic eagle. With a wingspan of more than two metres, it cannot pass unnoticed. In the mountainous regions of the northern hemisphere it flies over mountain meadows and looks for food with an occasional gentle whistling-sound. The food consists of marmots, hares, but also much larger animals. It also sometimes scavenges. Since the eagle is a faithful animal living as a couple for many years, males and females sometimes hunt together. As they say, two is better than one!

← STRONG EXTRAOCULAR MUSCLES

IT CAN SEE UP TO → 2 KILOMETRES

EAGLE VISION

It is not surprising that the eagle has excellent eyesight. Otherwise, how could it see a small mouse hiding in a patch of grass from a height of hundreds of metres? It's possible because it watches the world below with extraordinary acuity. Birds of prey can focus with an amazing degree of accuracy. This is attributed to the strong extraocular muscles that control its really big eyes. The eyes feature another great adjustment: in their centre, they perceive the image as slightly magnified. It is based on the same principle as if the eagle had a small telescope in its head.

NESTING

Eagle its nest on high trees or inaccessible rocks. Since it's important to keep one's home cosy, the eagle modifies, develops and enlarges its nest every year. The nest is thus usually one metre high and two metres wide! Such a structure needs to have a robust base, which can be attained with solid branches. The eagle then lines the nest with leaves and grass so that it is comfortable for eggs and eagle chicks.

↑ WINGSPAN UP TO 2 METRES

Interesting

THEY PERCEIVE THE IMAGE AS SLIGHTLY MAGNIFIED

THEY LIVE IN ROCKY → MOUNTAINS

← NEST IS PROTECTED BY EAGLE FOR YEARS

↑ SOLID CONSTRUCTION FROM STICKS

Birds of prey

BIRDS OF PREY INCLUDE A NUMBER OF SPECIES.FOR EXAMPLE THE LARGEST CINEREOUS VULTURE, OR MUCH SMALLER, COLOURFUL AMERICAN SPECIES, SUCH AS THE SOUTHERN CRESTED CARACARA AND THE TINY AMERICAN KESTREL. THE MIDSIZE OSPREY CAN BE ENCOUNTERED ALMOST ALL OVER THE WORLD.

SOUTHERN CRESTED CARACARA

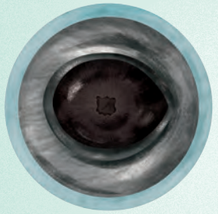
AMERICAN KESTREL

WESTERN OSPREY

CINEREOUS VULTURE

WEDDELL SEAL

Leptonychotes wedellii



↑
SHARP SIGHT EVEN UNDER WATER

Interesting

IT CAN LAST FOR AN HOUR WITHOUT BREATHING

GREAT SWIMMERS ↓

EXCELLENT → NAVIGATION SKILLS

↑
BREATHING HOLE IN THE ICE

- 290 to 330 cm
- Mammalia, Pinnipedia
- Antarctic and sub-Antarctic islands
- eyes adapted to the low light underwater

The land of floating ice is home to an almost half-tonne seal. This species is named after the famous British sailor, James Weddell. Like a sailor on a ship, the Weddell seal is an excellent swimmer with remarkable navigation skills. In winter, it forages for food below the surface of the frozen ocean, which is not an easy task for a predator that needs air oxygen to breathe. That's why the seal makes entry and breathing holes in the ice with its cuspids. Preventing the holes from being covered with ice is not the only thing, however, that seal has to be cautious about.

SEAL DIET

Are you wondering what the seal eats? It takes advantage of the plentiful supply of Arctic waters. It feeds on various fish, crustaceans and cephalopods. Despite the low light under the ice, it can find food easily as its eyes are well-adapted to the gloom. Even a small amount of light is sufficient for its eyes to distinguish one thing from another perfectly.

A PROFICIENT NAVIGATOR

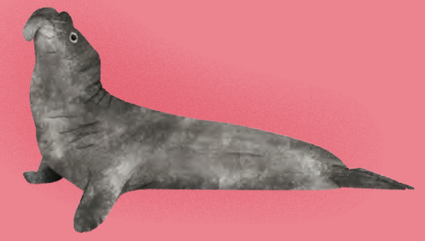
What else does the seal have to handle in the land of ice? Imagine that you dive for food to a depth of about six hundred metres. You can stay underwater for an hour during which you wander up to five kilometres away from the entry hole. You now surely get the idea of the other difficulties of seal life. If the seal deviates from the course to the hole in the ice even slighltly, it would never leave the waters of the murky Arctic Ocean. But don't worry. Due to its excellent navigation skills, the seal always finds the hole in the ice in time.

ADULT SEAL →

YOUNG SEAL ↓

Pinnipeds

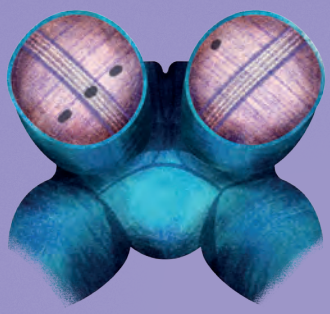
THE GROUP OF PREDATORS, THAT ARE FULLY ADAPTED TO LIFE IN THE AQUATIC ENVIRONMENT, IS CALLED PINNIPEDS. IT INCLUDES SEALS AND RELATED ELEPHANT SEALS, WALRUSES AND SEA LIONS.



SOUTHERN ELEPHANT SEAL

WALRUS

SOUTH AMERICAN SEA LION



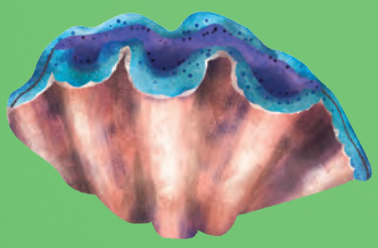


All about THE EYE

Written by Marie Kotasová Adámková
Illustrated by Matej Ilčík

Eyes are windows to the soul, they say. And there are as many kinds of eye as there are kinds of window. The book All About the Eye gives you a unique opportunity to investigate these 'windows of the soul' and to discover how they evolved and how they have affected the lives of their owners. You will travel across continents, as the book contains a large-format map showing where eyes described in the book come from. So, open your eyes wide and read carefully. If you read every word and study every illustration, you will soon know all about the eye.



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