ST. EDWARD'S
OXFORD

Teddies Talks
BIOLOGY

'Under the Sea'

11th Edition of the
St Edward's **Biology Society** Magazine

February 2023

Photo: Morgan Wrigley, U6th

Editorial

Dear Reader,

This academic year, members of the Biology Society ('BioSoc') have worked hard to put the TTB magazine together, starting in September 2022 when we decided the theme of the magazine, the articles we would write, and even some of the artwork in this magazine.

We chose '**Under the Sea**' as the theme for this issue as many of us were inspired from recently studying ocean chemistry as well as members of the BioSoc giving talks about marine biology. It is awe-inspiring to realise how little we know about what lies **under the sea** but learning about what we do know makes us feel even more connected with everyone around us. We only have one earth and *just one* large body of saltwater that interconnect to form the seas and oceans around us.

We hope you enjoy the articles!

Best regards,

Teddies Talks Biology Editorial Team and Contributors

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NOT a Basic Issue

Yukino Watanabe L6th

explores the link between anthropogenic climate change and ocean acidification

In the past few decades, increase in carbon dioxide emissions in the atmosphere has caused tremendous effects, from global warming to extreme weathers leading to the loss of many habitats and ecosystems around the world.

Within the years of 1994 to 2007, the ocean absorbed 34 billion metric tons of carbon in the air released by the burning of fossil fuels in the form of carbon dioxide. This may seem like a positive effect.

The ocean, which covers 70% of the Earth, is absorbing carbon dioxide in the air and reducing global warming. However, this comes with a price: the acidification of the sea water.

$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

When carbon dioxide is absorbed on the surface of the ocean, the following reaction takes place.

The carbonic acid produced is a weak acid which dissociates into hydrogen ion and bicarbonate ion. The increased concentration of the hydrogen ion is making the ocean to become more acidic than it was by 0.1 pH units, showing approximately a 30% increase in acidity. Changes in ocean chemistry have immense impact on many marine species especially calcifying organisms.

Calcifying organisms use calcium and carbonate in the ocean to build hard shells and skeletons out of calcium carbonate. This includes marine species such as crabs, oysters, scallops, corals, sea urchins and many more. They

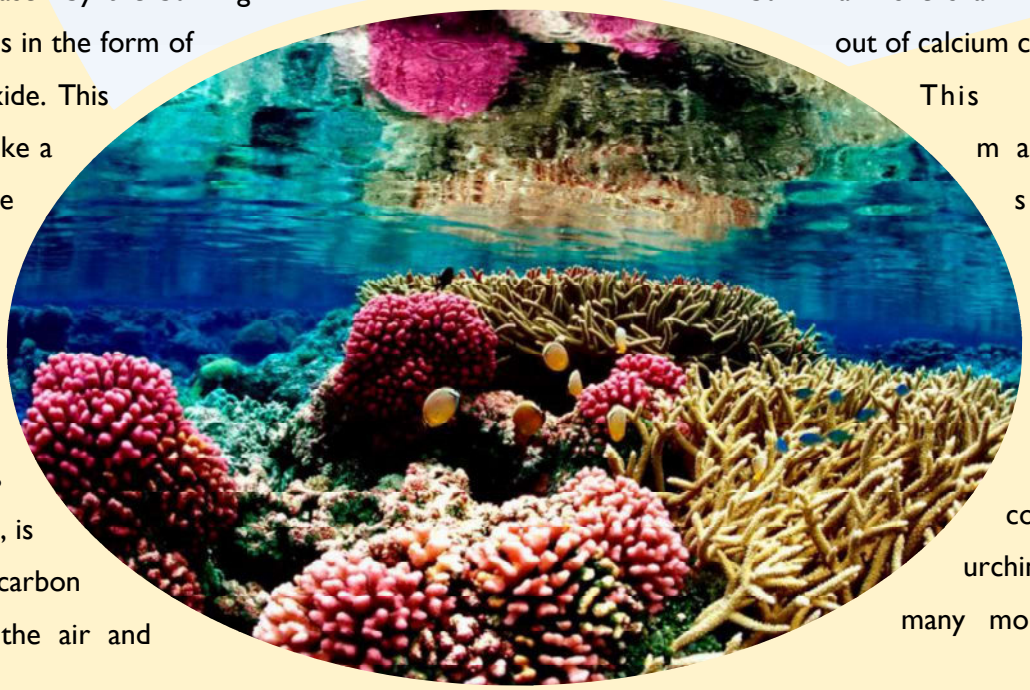

Photo courtesy of Jim Maragos / US Fish and Wildlife Service via Flickr

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are very sensitive to acidity. This is because when acidity increases, there is a higher concentration of hydrogen ions. Hydrogen ions bond with carbonate ions just like calcium ions do. However, hydrogen ions have greater attraction than the calcium ions. When hydrogen ions bond with a carbonate, a bicarbonate ion is formed. This results in fewer carbonate ions available for calcifying organisms to build their shells. If the pH level becomes too low in the future, their skeletons and shells may even start to dissolve.

Not only does ocean acidification affect shell-building species, but it will also have an impact on the behaviour of non-calcifying organisms. Some examples include the decrease in ability of clownfish to detect predators and locate its suitable habitat. It could also cause alarming changes in the behaviour of fish living on tropical reefs. Not only will their homes slowly start to debilitate due to the lack of carbonate ions, but it may also disorient fish, alter their vision, and lead them to become attracted to the smell of predators. Such changes could cause a huge drop in population of certain marine species.

Photo courtesy Hagainativ via WikiCommons, CC

This is a serious concern, as many fundamental calcifying species, which are important part of many food webs will decrease in number.

Usually, the ocean has a natural buffer for its pH level decreasing due to the absorption of CO_2. However, because the pH has dropped so quickly, the ocean hasn't had time to buffer and adapt. If the amount of carbon dioxide released in the atmosphere decreases to a natural level, eventually buffering will catch up and the low pH will be neutralised to normal sea pH level. However, this would take thousands of years.

So, what can we do to help prevent further damage? The quickest way to do this is by cutting down CO_2 emissions. This can take shape quickly and easily in our lives from today.

It does not have to be a big change, from using public transportation instead of private cars, turning the lights or heating off when not in use or using energy-saving light bulbs.

We have the power to start changing these habits, which will contribute to saving marine species from ocean acidification in the coming future■

No reel place like home

Hayden Lai L6th reveals the previously unsolved mystery of where the European eels come from

The origins of eels have always been a great mystery, a mystery that even the great Aristotle couldn't solve. Until recently scientists recently discovered the spawning grounds for both European and American eels in the Sargasso Sea.

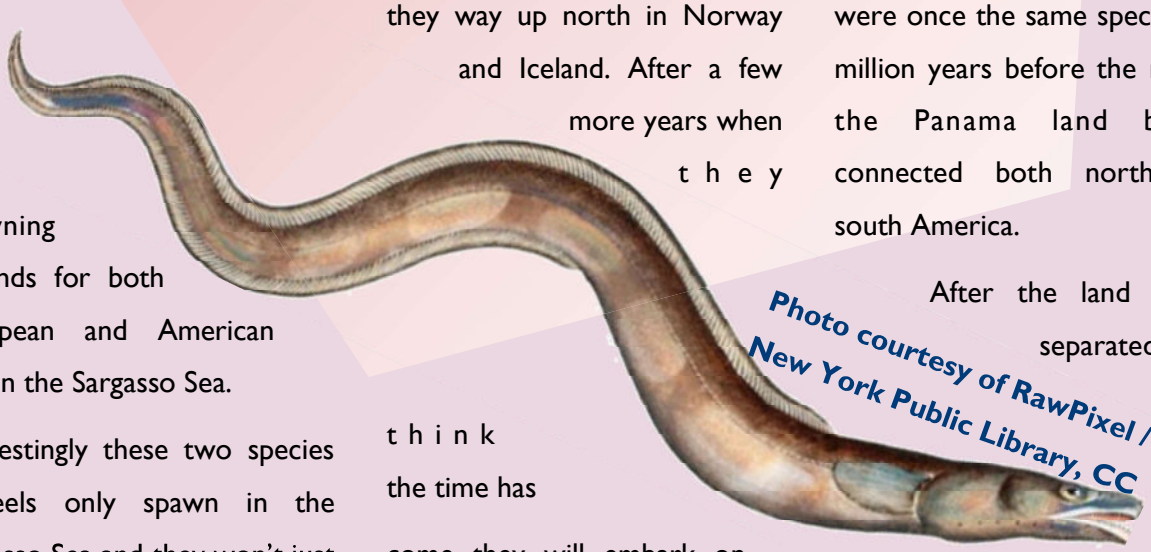


Photo courtesy of RawPixel / New York Public Library, CC

Interestingly these two species of eels only spawn in the Sargasso Sea and they won't just mate with a random eel upstream. Instead, they embark on an epic 5,000 kilometre journey just to mate. Now that's what I call dedication.

After the big breeding season is over, the newly hatched baby eel larvae will float all the way back to Europe as it follows the gulf stream and other currents in the ocean. After a couple of years pass, they decided to settle down after the big journey. They usually stay in rivers, lakes, and coastal waters. They can be found all the way down south in Morocco and all they way up north in Norway and Iceland. After a few more years when they think the time has come they will embark on another 5,000 kilometre journey to the Sargasso Sea to mate.

Surprisingly both American and European eels can breed together and have fertile offspring. This has always been a big mystery to modern day scientists as it was very difficult to see how both European and American eels are different species if they are able to breed. Until a group of scientists decided to compare the mitochondrial DNA of 50 American eels and 50 European eels. They discovered that both were once the same species 3.5 million years before the rise of the Panama land bridge connected both north and south America.

After the land bridge separated the Atlantic and the Pacific Oceans, the once singular species went separate ways and became two different species■

The Little Mermyth

Morgan Wrigley U6th views the Little Mermaid through the lens of marine biology

Merpeople, talking crabs, and evil sea witches may not be the most biologically accurate mix to reach the big screen, but there are many subtle overlooked details within the movie.

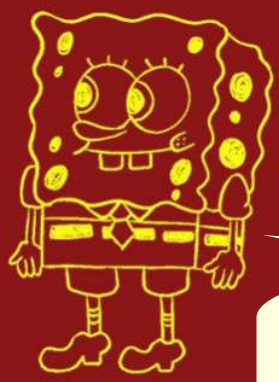
The Kingdom of Atlantica is presented as a utopia of tropical fish and colourful corals. However, being set in Denmark, the cold temperatures of the sea would not be able to support this level of tropical diversity. The North Sea's average temperature ranges from 6°C to 17°C. You could claim all this could be due to the magic of the Kind Trident, King of the Merpeople, but that's not the way a scientist thinks.

The vibrant colours of the tropical fish do give the movie a fun and more stimulating viewer experience in comparison to the primarily grey and brown fish native to Denmark.

Sebastian, or more formally known as Horatio Thelonious Ignacious Crustaceous Sebastian is a Red Jamaican crab. This species of crab is located in the Caribbean, west of Cuba, and as far as Barbados, but sadly not as far as the chilly waters of Denmark. However, Sebastian's species is heavily debated amongst Disney fans. Some claim that due to the length of his front claws his anatomy is that more similar to a lobster than a crab, even the Disney website references to him as a lobster even though he is referenced as a crab multiple times in the movie.

Ariel's beloved side kick 'Flounder' is a yellow and blue tropical fish. He is believed to be some type of angelfish or some other similar vibrantly coloured reef fish. However, he is definitely not a flounder fish as they belong to the flatfish species. The flounder fish is for the most part not dull coloured, normally brown and sand coloured so that that are able to camouflage with the sea floor.

Our final 'mistake' is with 'Ursula' the evil sea witch, whose lower body is that of an octopus, only has six purple tentacles rather than the standard eight. But one cannot judge a children's movie too harshly■



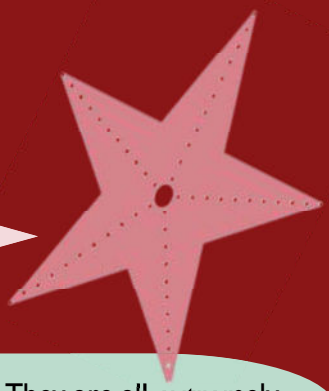
Karen Teng U6th dissects the marine animals in SpongeBob (not literally)

The series SpongeBob SquarePants which we all know and love is created by Stephen Hillenburg, an animator and marine science educator. SpongeBob was originally created as a comic character to help educate children on marine life before it was made to become a famous series - undoubtedly there are many biological facts hidden in this animation.

SpongeBob is a sea sponge. Nearly 9,000 species of sea sponges vary in shape, size, and colour and are found worldwide. They may have lumps, finger-like growths, urn shapes, or thin crusty bits. While they may look like plants, they are actually animals. A sea sponge feeds by filtering through water passing by. Their food are usually plankton like tiny molluscs or crustaceans. Hence the SpongeBob series is accurate on SpongeBob's rivalry with plankton!

SpongeBob SpeciesPants

Patrick belongs to one of over 2,000 different species of starfish or sea stars. Some live in deep water, others in shallow water. Sea stars do not have brains or blood, however, they are able to regenerate their own body parts and some form into a genetically identical starfish. Arms take months and even years to regenerate fully, so to avoid predation, they use camouflage. Sea stars move around on thousands of tiny tube feet—never like Patrick on two!



Squidward belongs to one of 800 species of cephalopods. They are all extremely intelligent animals, with complex nervous systems. Squidward is more knowledgeable than SpongeBob or Patrick shown by his amazing driving skills, portraying his species' characteristics! Most Cephalopods can camouflage themselves with the surrounding environment, using pigment molecules and light-reflecting organelles in their body cells. Not only can they change colour, but they can also change their texture to seamlessly blend in with rocks, corals, and sponges.

Snails like Gary often have coiled or cone-shaped shells. Gary's shell has very bright colours. Usually, sea snails have bright colours too, serving to warn about poison they carry. Snails crawl on a fleshy 'foot' spanning the length of their body and movements rely on hydrostatic pressure and muscle action. All gastropods have a head with a mouth and eyes often at the end of stalks, resembling Gary!

Life among the Corals

Bilegt Gantulga L6th takes us to the world of coral and the ecosystems that they create

Coral reefs are one of the most diverse **ecosystems** in the world, housing over two million **marine** animals! But what makes up these vast, colourful expanses?

Photo courtesy by Wexor Tmg via Unsplash

Corals are not actually rocks! At a microscopic level, the coral reefs you see are actually an amalgamation of different **invertebrates called polyps,** characterised by a sac-like body and a mouth, surrounded by stinging tentacles.

Photo courtesy by Ie vy via Pexel

Photo courtesy by SeaquestDS, CC

Corals use **calcium carbonate** from the seawater to develop a skeleton to protect the soft polyp body, as well as the algae in their tissues that gives them their colour. These polyps form **colonies** that merge, eventually forming a reef.

Sea turtles have a mutualistic relationship with corals. They depend on sea sponges as prey, and eating them prevent prevents corals from being outcompeted.

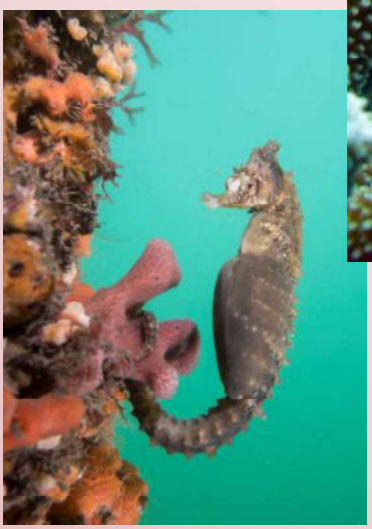
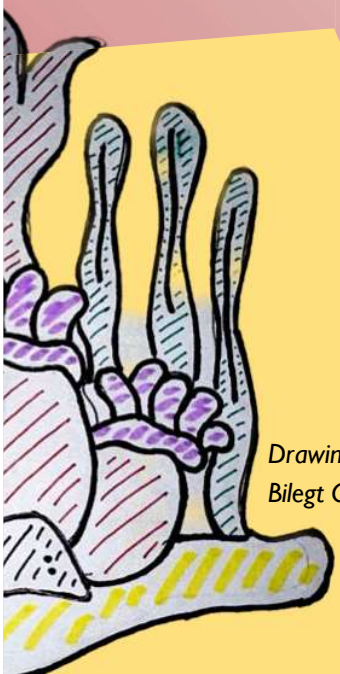


Photo courtesy by John Turnbull via Flickr

Seahorses are successful predators and masters of **camouflage** that use their spiralled tails to anchor themselves onto corals from which they snap at their prey at a great speed.



Drawing: Bilegt Gantulga, L6th

The shy clownfish have a **mutualistic** relationship with corals where clownfish shelter within the polyps from predators and the clownfish feed corals and sea anemones with their faeces.

Aquatic Ape: Hype or Theory?

L6th explores the controversial theory that our ancestors once lived in or around water

Human evolution is the process by which humans developed on Earth over time from now-extinct primates by natural selection. The Aquatic Ape Theory states that our ancestors once spent a significant part of their life in or around water.

Evidence supporting The Aquatic Ape Theory

The theory was first suggested by Sir Alister Hardy, a marine biologist in 1960, Homo Sapiens' many notable differences from the then-claimed human ape predecessors were used as evidence. This theory was then popularised in the 1970s and 1980s by the writer Elaine Morgan.

Our hairless body, which made us more streamlined for swimming and diving; our upright, two-legged walking, which made wading easier; and our layers of subcutaneous fat, which kept us warm in water are assumed to be the result of our aquatic lifestyle. According to the hypothesis, even the evolution of human speech is related to aquatic lifestyle.

Dr. Rhys-Evans is a doctor specialising in ENT (ears, nose, and throat), who authored a book about human evolution named 'The Waterside Ape'. He proposes evidence that the adaptations of mammalian hearing systems differ in aquatic, terrestrial, and semi-aquatic species, which supporters claim explains why humans resemble semi-aquatic mammals like seals, which all have mechanisms to constrict the ear canal because of long-term exposure to water.

Limitations of the Aquatic Ape Theory

The theory, on the other hand, has garnered so much criticism that it is not even included in human evolution textbooks. Palaeoanthropology is the study of human evolution. Hair, skin, fat, and sweat are not fossilised. As a result, paleo-anthropologists have prohibited such matters from being discussed. Many of the described anatomical and physiological adaptations cannot be fully explained by the semi-aquatic theory. For instance, while fully aquatic mammals such as whales and dolphins are hairless, semi-aquatic mammals such as otters and water voles are extremely furry.

In addition, although coastal resources are parts of our ancestors' diet, humans have been shown to thrive on food obtained entirely on land. There is also evidence that our ancestors had to survive periods of extremely dry climate with little or no aquatic resources.

Lastly, there are no traces of human fossil records of a hominin ancestor as aquatic as described by Hardy and Morgan.

While Hardy-Elaine's Aquatic Ape Theory brought new perspectives to traditional thinking about human origins, it has not been well supported based on our growing fossil, comparative anatomy, and genetic data■

Carina Upson Sandlund L6th explores the topsy turvy world of a very special, aquatic invertebrate, the scavenger beetle

which way up?

Scientists have intensively studied insects' special relationship with water and how they take advantage of the surface tension of water. Water molecules stick together more tightly at the surface, making it resistant to external force. This surface tension allows certain insects such as the water striders whose legs are covered in water-resistant hair to walk on top of the water without getting wet.

However, scientist have recently discovered that this surface tension may also allow some insects to walk underneath the water. In 2015, Dr John Gould, a behavioral biologist at the University of Newcastle in Callaghan (Australia) was amazed by the sight of a beetle crawling along the underside water as if it was crawling on the underside of a sheet of glass. He quickly whipped out his phone to take a video of this strange phenomenon but then forgot all about it.

That is, until June 2021, when Gould and Jose Valdez, a wildlife ecologist in Lepzig, Germany published a report on the behaviour of the beetle in the journal Ethology.

Photo courtesy of Bernard Dupont, WikiCommons, CC

The beetle has since been identified as a water scavenger beetle (Hydrophilidae).

However, we are still not entirely sure what allows the beetle to walk upside down under the water's surface.

Researchers think that the beetle may use an air bubble against their abdomen which allows them to put pressure on the underside of the water.

Though the beetle never breaks the water's surface tiny hills of water were observed rising from the beetle's legs. How the beetle is able to stop the bubble that close to the surface from bursting and how it gains traction underwater still remain a mystery.

Additional research is now being carried out in an attempt to solve these mysteries and Dr Gould hopes that this research could help the development of inspire tiny, upside-down surfing aquatic robots■

Photo courtesy of Andrew C, WikiCommons, CC

Photo courtesy of Peter Southwood, WikiCommons, CC

Which species under the sea is the coolest?

Grace Baffoh Botchway
L6th believes the salp is the coolest under the sea

When we think about the coolest marine species some of us think about the sharks and dolphins. When I think of the coolest marine species, I say it's salp. Salp are small, barrel-shaped, and transparent animals up to 10cm in length each and often mistaken for jellyfish.

Surprisingly, they are more closely related to humans than jellyfish despite their strikingly close resemblance. They have a structure similar to vertebrates.

Their lifestyle is also intriguing. Their intake of nutrients is so efficient that they are constantly growing without getting tired.

They are adapted to floating on the surface at night time where they can obtain a rich supply of food. It swims back down in the daylight in order to hide in the depths of the ocean where it is shielded and protected from any potential predators.

They use jet repulsion, contracting to push water out. They are thought to be the fastest growing multicellular organism on earth as their length increase by 10% each hour.

The presence of salp is crucial for the regulation of plankton population as when plankton grow out of control they produce harmful algal blooms which are harmful to sea life. Bacteria and plankton are among their other food items.

They are as important alive as they are dead as due to their abundance their carbon rich bodies influence the ocean's biological pump. As a result, this could affect the carbon cycle and potentially play a role in climate change■

Photo courtesy of Lars Plougmann, WikiCommons, CC

Who won this debate? You decide.

Photo courtesy of Cédric Péneau, WikiCommons, CC

The Peacock mantis shrimp can live for over 20 years which is outstanding for any type of animal that ranges from 5cm to 18cm in length. You can understand how living so long is like for us humans to live for 200 years. Moreover, did you know that there are over 450 species of mantis shrimp. Rather you could easily find one by the coasts of the Pacific Ocean which makes them very exciting because like some other animals you cannot really see because of how rare they are which arguably means that they aren't as cool. However all that I have just said is nothing compared to what I will say next. The peacock mantis shrimp has the strongest punch in the animal kingdom, stronger even than a gorilla. The reason it has the strongest punch is that its claw appendage opens and closes so quickly that when it wants, it can create a bubble with an acceleration of a .22 calibre bullet with temperatures reaching up to 4000°C which is about four times as hot at lava and nearly as hot as the sun!

Absolutely no animal can even come close to the strength and the capability of the peacock mantis shrimp, because of all of this, I believe that it is absolutely the coolest animal in the world and no one can deny it■

Cosimo Gualandi 4th believes the peacock mantis shrimp is cooler

Photo courtesy of Elias Levy, WikiCommons, CC

infection in the ocean

Lucy Evans L6th chronicles the raging war between pathogens and hosts *under the sea*

Infectious diseases have severely affected marine organisms, from wasting diseases in sea stars to phocine distemper in seals.

Increases in mortality from recent disease outbreaks raises the question over whether the risk of infectious diseases in oceans today is greater than in previous years. However the lack of long-term records on marine disease hinders any efforts to quantify whether the incidence of marine disease has altered.

Reports of deaths due to disease in marine mammals have been increasing since 1996, however this could in part be due to increased surveillance. It is also likely that scientists are still underestimating the true numbers of outbreaks in these populations, especially due to the difficulties in measuring these figures.

Infectious diseases occur in all ecosystems, and play a crucial role in structuring biological communities. Changes in disease risk can be caused by abiotic and biotic components of environmental change due to disruptions to host-parasite interactions. In recent decades, ocean conditions have altered dramatically due to climate change, pollution, overfishing and invasive species. Marine animals can become infected from ingesting contaminated water, or eating infected prey. The presence of these pathogens may also provide an indicator of pollution levels in the ocean.

Photo courtesy of CDC via Unsplash

Bacteria are the most common cause of mass die-offs but these tend to be less severe. A viral outbreak causes on average 7,000 marine mammal deaths, while a bacteria-induced mass mortality event causes 350 deaths.

A research team led by Woods Hole Oceanographic Institution collected and analysed samples from 370 marine animals, encompassing 33 marine species. All together they found nearly 100 types of disease-causing agents in their specimens.

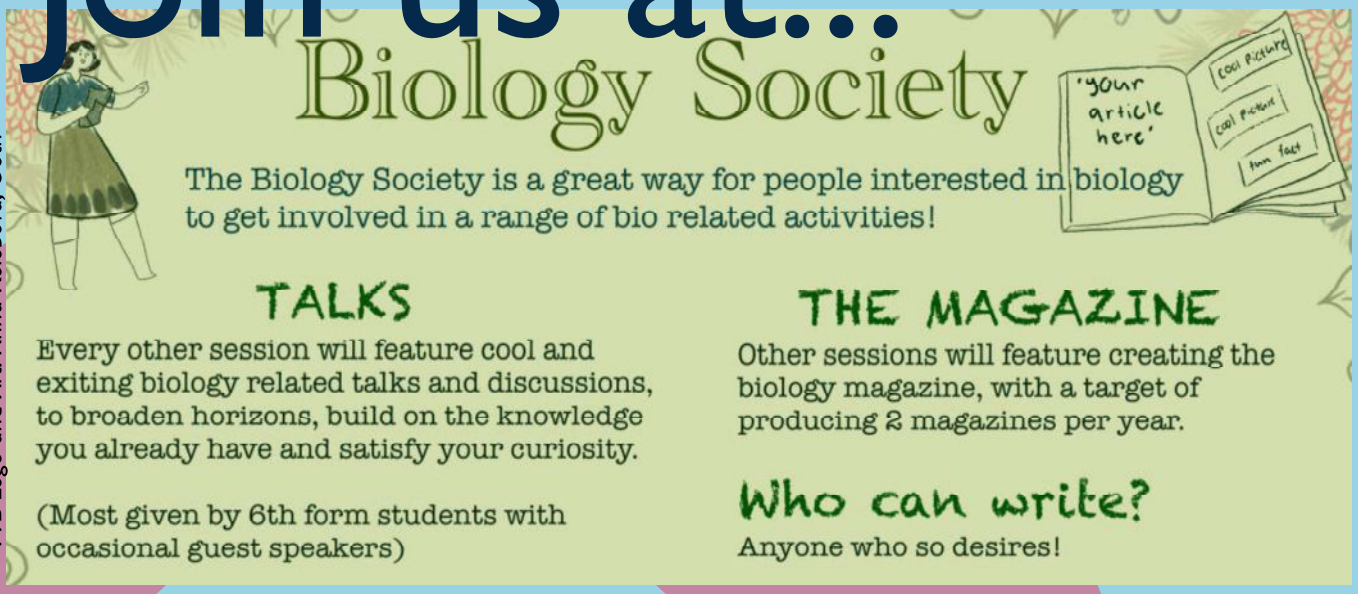
The researchers also discovered a high degree of antibiotic-resistant bacteria in the ocean harboured in the animals they tested. This discovery raises concerns about the severity of contamination of antibiotics in coastal waters as well as questions over whether marine animals can act as reservoirs for pathogens.

Furthermore, marine life may not only suffer from the zoonotic pathogens themselves but act as vectors, moving these human pathogens to different geographical locations in the ocean.

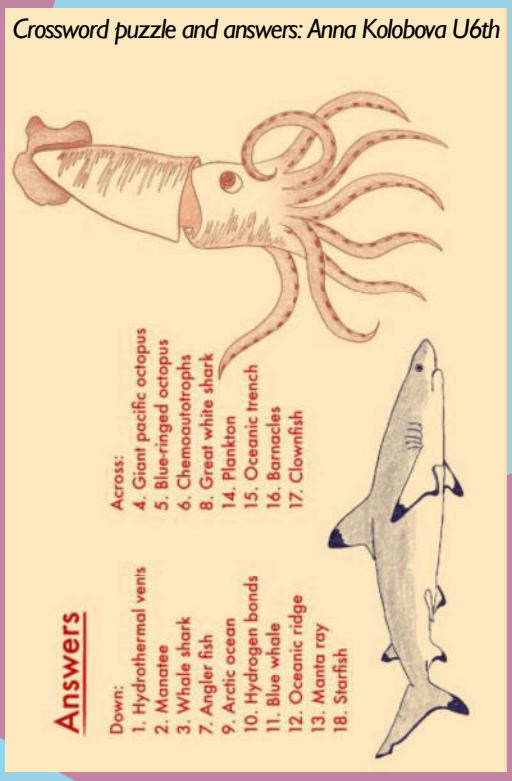
This increase in marine life has catastrophic effects as we are losing species which other things depend on to keep the whole food web system operational■

Love **Biology**? Join us at...

TTB Logo and Art: Anna Kolobova, U6th



Crossword puzzle and answers: Anna Kolobova U6th



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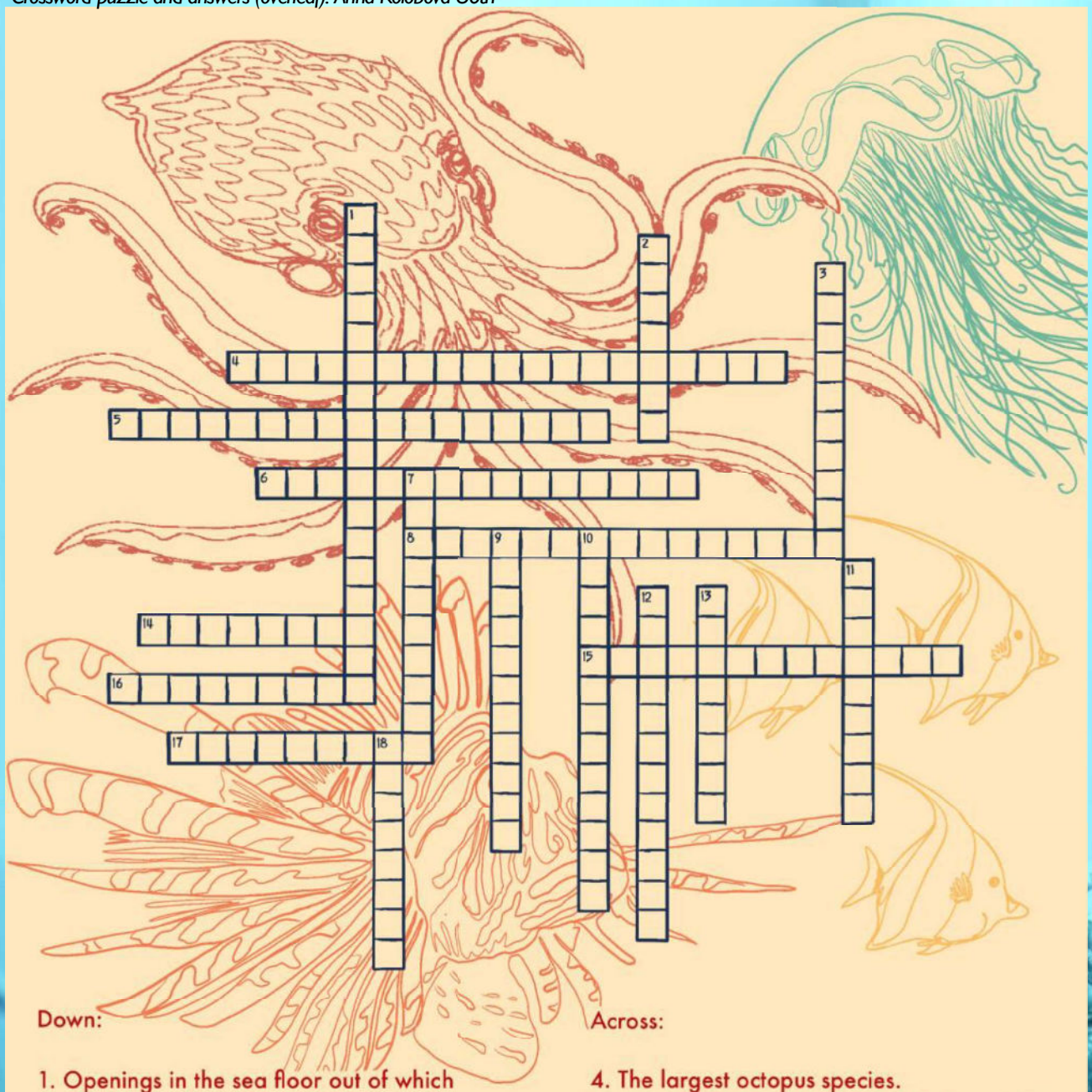
Crossword puzzle and answers (overleaf): Anna Kolobova U6th



Down:

1. Openings in the sea floor out of which heated mineral-rich water flows.
2. A large, fully aquatic, mostly herbivorous marine mammal, also known as a "sea cow".
3. A very large, slow-moving, filter-feeding fish. The largest living non-mammalian vertebrate.
7. A fish that lives in the murky depth and has a bioluminescent lure (females only).
9. The smallest ocean.
10. Interractions between water molecules.
11. The largest animal on the planet.
12. A seafloor mountain system formed by plate tectonics.
13. The largest ray species.
18. Patrick.

Across:

4. The largest octopus species.
5. A small, highly venomous cephalopod that has made it to "Species of the Week".
6. Organisms that create their own energy and biological molecules from inorganic chemicals.
8. The species of the shark in Jaws.
14. Microscopic organisms that drift around the oceans and are a crucial food source.
15. A deep valley on the ocean floor.
16. Sticky little crustaceans found in rocky tide pools.
17. Nemo.