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OCEAN BULLETIN

Why do sharks have two genital organs?
How stress affects your health?
Origin of ocean basins- a unexplored truth
You may saw the ocean but do you have idea about the crust?
Do you know the age of the earth?

SCHOOL OF MARINE SCIENCES
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OCEAN BULLETIN

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WHY DO WE CELEBRATE WORLD OCEANS DAY?

- To remind everyone of the major role the oceans have in everyday life. They are the lungs of our planet, providing most of the oxygen we breathe.
- To inform the public of the impact of human actions on the ocean.
- To develop a worldwide movement of citizens for the ocean.
- To mobilize and unite the world's population on a project for the sustainable management of the world's oceans. They are a major source of food and medicines and a critical part of the biosphere.
- To celebrate together the beauty, the wealth and the promise of the ocean

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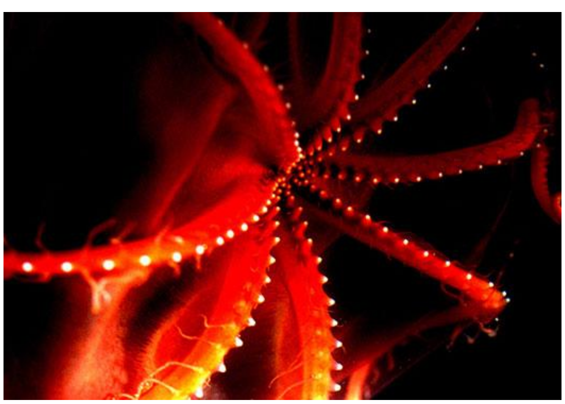
HOW SEA EMITS LIGHT IN NIGHT?

Bioluminescence is the production and emission of light by a living Organism. It is a form of chemiluminescence. Bioluminescence occurs Widely in marine vertebrates and invertebrates, as well as in some fungi,microorganisms including some bioluminescent bacteria and terrestrial Invertebrates such as fireflies. In some animals, the light is produced by symbiotic organisms such as *Vibrio* bacteria. The principal chemical reaction in bioluminescence involves the light emitting pigment luciferin and the enzyme luciferase, assisted by other proteins such as aequorin in some species. The enzyme catalyzes the oxidation of luciferin. In some species, the type of luciferin requirescofactors such as calcium or magnesium ions, and sometimes also the energy carrying molecule adenosine triphosphate (ATP). In evolution, luciferins vary little: one in particular, coelenterazine, is found in nine different animal (phyla), though in some of these, the animals obtain it through their diet. Conversely, luciferases vary widely in different species. Bioluminescence has arisen over forty times in evolutionary history. Some bioluminisense organisms are follows.

1. **Blazing Bioluminescence**



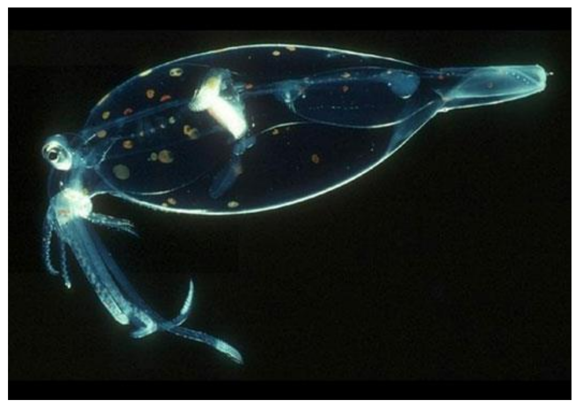
To truly appreciate the wondrous beauty of life in the ocean, you have to see it at night. When the sun sets, it comes to life in a dazzling display of colors and lights that rivals the best fireworks shows.An astonishing variety of species use bioluminescence (the natural production of visible light through a chemical_reaction) to catch food, hook up with mates, or scare off intruders. In this gallery, we'll look at some of the wildest, and most clever, uses of light at sea.

Being without adhesive suckers would seem to put you at a major disadvantage if you're an octopus, but the deep-sea octopus *Stauroteuthis syrtensis* manages just fine. In the place of the usual suckers are rows of flashing photophores, which the octopus cannily uses to lure its prey to certain death or to startle intruders.*Stauroteuthis* feeds on small crustaceans that are attracted to light. Once the unsuspecting critter is close, the octopus grabs it and traps it within a mucus web produced by glands on its arms. In the fi to document *Stauroteuthis*' bioluminescence, Duke University's Sonke Johnsen and colleagues observed that, when disturbed, the octopus splayed out its arms and exposed all its flashing photophores in an attempt to scare off unwanted guests

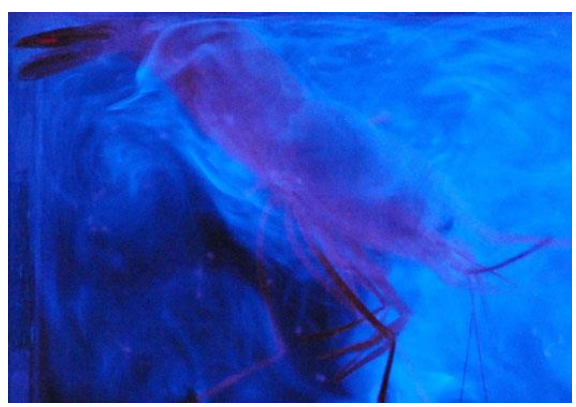
2. Glowing Ooze

Some species know how to make a quiet exit. But the deep-sea shrimp retreats in a blaze of bioluminescent glory. When confronted by a predator, the bright red critter spews a glowing blue ooze from the base of its antennae into the water.The light temporarily stuns the offender, giving the shrimp precious time to back-flip its way to safety. It's similar to the time-tested strategy used by squids and octopuses, which squirt clouds of ink into the faces of their enemies

3. Shiny, See-Through Squid

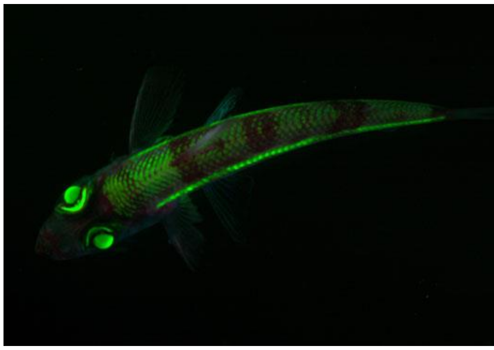


The glass squid is a master of luminous disguise. Unlike the many species that



use bioluminescence as an attention-grabbing beacon, this animal uses light as a cloak to evade prying eyes.Aside from its opaque eyes and the polka dotlike chromatophores (pigmented cells that aid in camouflage) that cover its body, the glass squid is completely transparent. The chromatophores are not an issue, but the opaque color of its eyes can be a dead giveaway. Many species hunt for prey by scanning the water column above them, looking for any telltale silhouettes that might signal the presence of their next meal.To confound its potential predators, the glass squid makes use of two U-shaped light-emitting photophores located at the base of its eyes: the lights cancel out the shadows cast by the opaque eyes. The effect of his strategy, called counterillumination, is to break up the squid's silhouette by mimicking the intensity and color of downwelling light from the surface.

4. Small Fish, Big Freaky Eyes



To survive in the dark recesses of the ocean, it helps to have a sharp pair of eyes. And preferably eyes that can see through others' visual deceits. On both counts, the short nose green-eye fish swims above the fray.

Like many deep-sea predators, its eyes are turned upward to scan for prey blocking the light that comes from above. But where another fish might have been fooled by a prey using counterillumination, the short-nose green-eye fish uses its sophisticated peepers (pdf) to break up any bioluminescent shams.

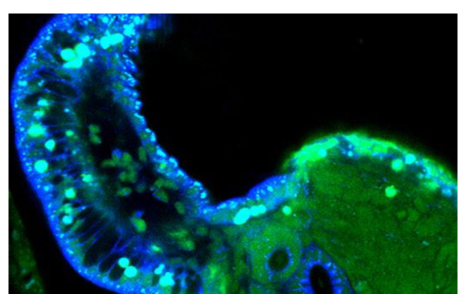
The green fluorescent pigment in the lenses of its eyes acts like a filter, absorbing the sea's ambient deep blue light. Researchers believe this property allows the short-nose green-eye fish to distinguish between the lighter shade of blue given off by bioluminescent creatures and the richer blue of the ocean

5. Woo the Ladies, Scare the Rivals

The tropical mantis shrimp is known for one thing above all else: its amazing eyes. Unlike our own primitive eyes, which detect three primary colors, the mantis shrimp's can see 12. They can also perceive different forms of polarized light--light waves oscillating in a single direction. This ability is primarily thought to help the shrimp nab the transparent animals that it feasts on.

On the dimly lit seafloor, where the shrimp dig their burrows, their complex eyes have another crucial function: interspecies communication. Pigments in the shrimp's appendages absorb the ocean's ambient blue light and emit it in a yellow-green color, resulting in the characteristic spotty markings. The light's wavelength is so specific that only other members of the species can trace it, which allows the mantis shrimp both to flaunt its goods to prospective mates and to threaten encroachers.

6. Bright, Shining Symbiosis

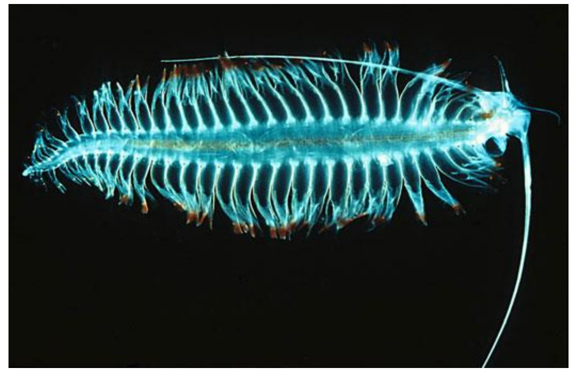


At first blush, the Hawaiian bobtail squid looks like just another bioluminescent cephalopod. Like many of its relatives, the bobtail squid makes deft use of its light-emitting photophores to hunt, communicate with its peers, and hide from predators lurking below. But it's a fraud. Instead of producing the light itself, the squid relies on_a bioluminescent bacterium that dwells within its photophores. In exchange for shelter and a stable source of nutrients, the bacteria provide the squid with the ability to make light. The relationship begins immediately at birth. After emerging from its egg, the juvenile bobtail squid acquires the bacteria from the environment, and they start the process of colonizing its developing light organs.Studies have shown that the squid can even control the intensity of the luminescence produced by the bacteria in order to match that of the down welling light in the water column

7. Beware of Red Treats

The deep-sea siphonophore, which makes red light to trap its prey. A close relative of the jellyfish, it was recently discovered by a team of Monterey Bay Aquarium Research Institute (MBARI) researchers. Like all siphonophores, this unnamed species is what scientists call a "superorganism": an animal that grows by budding off highly specialized structures, known as zooids. Each zooids performs a specific function, such as feeding or reproduction. This creature's feeding zooids employ unique red "lures" at the tips of some tentacles to catch unwitting passers-by. To the fish that fall for the alluring bait, the red fluorescent tip looks just like a fat, juicy crustacean. The dangling blobs themselves are harmless, but nearby tentacles are equipped with a battery of potent stinging cells, that make quick work of the small fish. Photophores contained within the tips are responsible for producing the red light. MBARI scientist Steven Haddock believes the lures are an adaptation for living at depth, where food is scarce and fish are even scarcer.

7. Yellow with Anger



Tomopteris, a tiny marine worm, erupts into a shower of angry sparks and unloads its eggs into the water before rapidly undulating away. What is unusual about this worm is that the sparks it shoots from its paddle-shaped swimming legs are golden yellow in colour and not blue, like practically every other bioluminescent organism. Other marine worms are thought to release glowing blue particles into the water to make themselves look less tasty to hungry predators. Few deep-living species have the ability to detect yellow light, which, because it has a higher wavelength, gets absorbed in the shallow surface waters, so it is unclear why *Tomopteris* uses it. For the moment, researchers are still trying to suss out the chemistry of the yellow luminescence, which may yield some clues about its unique function.

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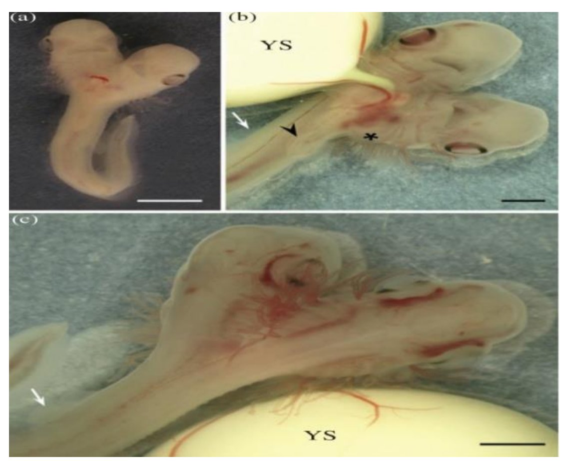
TWO-HEADED SHARK DISCOVERED IN SPAIN-A BABY SHARK WITH TWICE THE BITE.

While examining hundreds of Atlantic sawtail catshark embryos for a study on cardiovascular development, researchers in Spain noticed one with some unusual features: "Two heads, each of them with a mouth, two eyes, a brain, and five gill openings on each side," says Valentin Sans-Coma, a zoologist at the University of Malaga who led the team that discovered the Cerberean shark. "There were two hearts, two esophaguses, two stomachs, two livers, but only a single intestine," he says. This phenomenon, known as dicephaly, had never before been documented in an egg-laying shark species.



The two shark embryo alongside its yolk sack.

Scientists have previously seen dicephaly in ovoviviparous (where eggs develop and hatch within the female) and in viviparous (livebearing) shark species, but this is the first instance in an oviparous (egg-laying) species. The discovery suggests dicephaly may be more common in sharks than previously believed. Scientists still don't know exactly what causes dicephaly in sharks, but Sans-Coma believes the cause is a genetic fluke rather than environmental conditions. Scientists first described dicephaly in sharks in the 1930s, but it was reported in news outlets as early as 1838, says Michelle Heupel, a researcher at the Australian Institute of Marine Science who was not involved in the current study. Dicephaly has also been seen in other vertebrates, including reptiles and mammals. To date, scientists have never seen a dicephalous shark survive to adulthood. "Survival after birth may occur, but would likely be very brief," says Heupel. "It is unclear whether the two heads will preclude swimming and prey capture, and whether joined internal organs will function adequately." Despite this lethality, she noted that such deformities are extremely rare and therefore do not pose a conservation threat to shark species.

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WHY DO SHARKS HAVE TWO GENETAL ORGANS?

The male shark circles, grabs onto the female's pectoral fin with his mouth and bites down. He keeps a tight grip with his sharp teeth while she remains motionless. He slides in alongside her and curls his body in an arch. The act is complete when he uses one of two claspers to copulate and impregnate the female.

What is a clasper?

Similar to a penis, claspers are an external appendage found on male sharks, skates, and rays that are designed to deliver sperm inside of a female. However, they are dissimilar to a penis in that they are not an independent appendage, but rather a deeply grooved cartilaginous extension of the sharks pelvic fins.

Internal fertilization

Unlike a majority of fish that release eggs and sperm into the water for external fertilization, sharks fertilize their eggs internally. A major disadvantage of internal fertilization is the limitation on the number of young one can have at one time because growing young internally takes up space. Conversely, a major advantage of internal fertilization is the extended period of parental care that increases long term survival.

Sperm delivery

In order for female sharks to give birth to live young or fertilized eggs, males must be able to deliver sperm internally to the female. The clasper, just like the penis, is another of evolution's unique methods for this delivery.

But why are there two claspers?

Male sharks have two claspers because sharks have two pelvic fins. The claspers are simply a modified portion of the pelvic fin, and since there are two pelvic fins, there are two claspers.

Do they use both at the same time?

Interestingly, research suggests that sharks only use one clasper at a time. Shark mating has rarely been observed, but when observed, often involves the clasper on the opposite side of the body from where it has sidled up to the female. Perhaps this allows a better range of motion.

Another group of fish that are not closely related to sharks have also developed a penis like appendage strictly for the purpose of sperm delivery. Subsequently, the females in this group also give birth to live young. The group (Poeciliidae) as a whole are called live-bearers because of this distinguishing trait. Unlike sharks, the penis-like appendage on these fish is not a part of the pelvic fins. Rather, this appendage, called a gonopodium, is part of the anal fin. Since these fish only have one anal fin, male live-bearers only have one gonopodium instead of two claspers like sharks.

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HOW STRESS AFFECTS YOUR HEALTH?

Stress: We've all felt it. sometimes stress can be a positive force, motivating you to perform well at your piano recital or job interview. But often — like when you're stuck in traffic — it's a negative force. if you experience stress over a prolonged period of time, it could become chronic — unless you take action.

A natural reaction:

Have you ever found yourself with sweaty hands on a first date or felt your heart pound during a emotional movie? Then you know you can feel stress in both your mind and body. This automatic response developed in our ancient ancestors as a way to protect them from predators and other threats.

Faced with danger, the body kicks into gear, flooding the body with hormones that elevate your heart rate, increase your blood pressure, boost your energy and prepare you to deal with the problem. These days, you're not likely to face the threat of being eaten, but you probably do confront multiple challenges every day, such as meeting deadlines, paying bills and juggling childcare that make your body react the same way.

As a result, your body's natural alarm system — the "fight or flight" response — may be stuck in the "on" position, and that can have serious consequences for your health.

Pressure points:

Even short-lived, minor stress can have an impact. You might get a stomach ache before you have to give a presentation, for example. More major acute stress, whether caused by a fight with your spouse or an event like an earthquake or terrorist attack, can have an even bigger impact. Even loved one sudden death may cause stress. Although this happens mostly in people who already have heart disease.

.. *Some people don't know they have a problem until acute stress causes a heart attack or something worse.*

Chronic stress: When stress starts interfering with your ability to live a normal life for an extended period, it becomes even more dangerous. The longer the stress lasts, the worse it is for both your mind and body. You might feel fatigued, unable to concentrate or irritable for no good reason, for example. But chronic stress causes wear and tear on your body, too. Stress can make existing problems worse. In one study, for example, about half the participants saw improvements in chronic headaches after learning how to stop the stress-producing habit of "catastrophizing," or constantly thinking negative thoughts about their pain. Chronic stress may also cause disease, either because of changes in your body or the overeating, smoking and other bad habits people use to cope with stress.

strategies for reducing stress :

•***Identify what's causing stress.***

•***Build strong relationships.***

•***Walk away when you're angry.***

•***Rest your mind.***

•***Get help.***

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ORIGIN OF OCEAN BASINS -A UNEXPLORED TRUTH

Today, more than 2/3 of Earth is covered with water, mostly in our oceans. But Earth itself is much older than our oceans. In this lesson you'll explore theories on how our oceans formed, as well as why liquid water remains on Earth even after all this time. Earth Is a Wet Planet About 70% of Earth's surface is covered with water. And most of that, about 97%, is in the oceans. That's right - all the glaciers, ice caps, aquifers, groundwater, rivers, lakes, and streams only make up 3% of Earth's surface water! But the surface of Earth was not always so wet. In fact, Earth was a very dry place for some time after its formation. It's believed that Earth is about 4.5 billion years old, and that our oceans are only about 3.8 billion years old. There are two main theories describing how the oceans on Earth formed. First, it is theorized that Earth was formed with water and that this water came from the inside out. The other theory is that Earth did not contain any water when it was formed and it was instead brought here by other sources as they hit the young planet. We don't know for sure which is true, or if one is truer than the other. Many scientists favor the first theory as the major source of Earth's ocean water, but most believe it is some combination of the two. For this lesson, we'll discuss the formation of the oceans using both theories so you can see how each method could have contributed to the process. Ocean Formation Our solar system originally started as a large swirling cloud of various gases, ice, and dust particles. Eventually, these components aggregated together in different ways to form the planets that make up what is now our solar system. Early Earth was a very inhospitable place. It is believed to have been formed from meteorites, but it didn't start out with the neatly divided layers we have today: the inner core, the outer core, the mantle, and the crust. As this differentiation or geological separation of layers by density was occurring, there was also much releasing of gases onto Earth's surface through volcanic activity, a process called out gassing. And, while all this was going on, Earth was also being bombarded with materials from outer space, such as comets. These space materials also brought gases to Earth, and eventually these gases as well as those from out gassing formed our early atmosphere. Earth's early atmosphere was H-O-T! It trapped heat on Earth like a greenhouse so that temperatures on the surface were possibly as high as 400 °C! While water did not exist in the atmosphere in a gaseous state, it was way too hot for any liquid water. It would have simply boiled in that extreme heat, instantly turning to gas and rising into the sky. Throughout the next several million years, the atmosphere and surface cooled. Temperatures came down to below 100 °C, which allowed water to remain in liquid form. Much of the water vapor in the atmosphere fell to Earth and filled shallow basins in the ground that eventually became the large, deep oceans we have today. Keeping Water on Earth's Surface As we have seen with other planets, just because there is surface water at one time doesn't mean it will stay there. For example, it is likely that both Venus and Mars once had liquid water on their surfaces, but there is no evidence that it still exists on either planet. Retaining water on the surface of a planet is tied to several different factors. First, Earth is in a 'sweet spot' in the solar system. This is because it's just close enough to the sun to stay warm, but far enough away to stay relatively cool. It's also a good size. Earth is large enough that its gravity holds the atmosphere in place, protecting Earth's surface from both receiving and losing too much heat from solar radiation. The composition of Earth is also an important element. The outer planets in our solar system, Jupiter, Saturn, Uranus, and Neptune, are comprised mainly of gas. In contrast, the planets that are closest to the sun, Mercury, Venus, Earth, and Mars, are mainly rock and heavy metal. It would be difficult for liquid water to form on the gas planets because they do not have solid surfaces like Earth and the other rocky planets do. Below Earth's surface though is the mantle, which is where most of Earth's water is believed to exist.

Most of the earth's surface is covered by oceans, but for a long time the oceans have been an essentially white spot on the map of the world. Early expeditions like that of the Beagle (Charles Darwin) brought some preliminary knowledge, compilations of data by ship captains brought some initial knowledge about ocean currents and migration of fish swarms (mention Melville, Captain Ahab), but by and far we did not know much about the topography of the ocean floor, much less about its geological features. Starting at around 1930, however, a vast amount of knowledge has been gathered about the oceans, about their water chemistry, the cycling of elements, biological aspects, bathymetry, bottom sediments and their stratigraphy. Though much less spectacular and not as well publicized, the progress in knowledge about the oceans is far more important for the future of mankind than to send a few men to the moon. Ocean research has implications for food resources, the supply of raw materials for a growing population, and possibilities of ocean population by man (giant raft cities in shallow seas, platforms moving with food-rich ocean currents, etc.). Work on the bathymetry of the ocean basins (mainly with echo-sounding devices) has revealed many morphologic features that were previously unknown, such as oceanic ridges, abyssal plains (and hills), seamounts, trenches, and continental margins, all of these features are now easily explained by plate tectonics. Map of the Atlantic and Eastern Pacific Basin. Mid-Oceanic Ridges (marked with white arrows) are extensive. These are the youngest portions of the ocean basins where new ocean crust is generated through mantle upwelling and plate divergence. Taken together the oceanic ridge system of the earth is about 65000 km long and extends all around the globe. Map of the Pacific Basin and parts of the central Atlantic.

Continental Shelf = flooded edges of the continents.

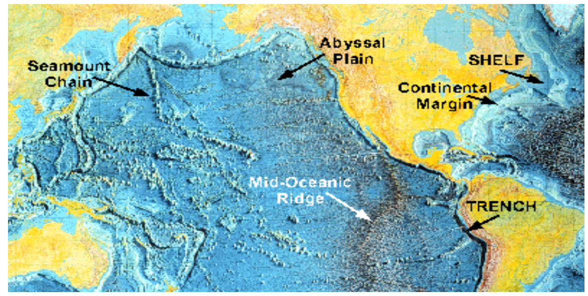
Continental Margin = the edge/ border region of the continent.

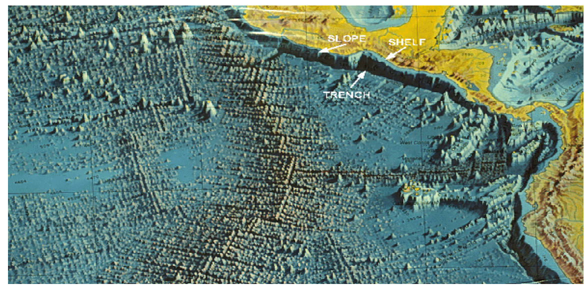
Deep Sea Trenches = deepest parts of ocean basins (due to subduction of oceanic crust).

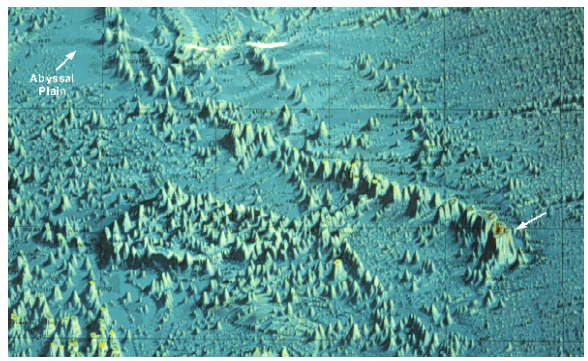
Abyssal Plains= older parts of oceanic crust, smoothed due to sediment deposition.

Seamounts = submarine volcanic cones; the can also form linear arrangements, so called Seamount Chains.

Continental margins are in a geological sense not part of the oceanic crust. They consist of continental crust and material that was eroded from the continents and is now piled up along the margins of the continents. The margins are subdivided into CONTINENTAL SLOPE and SHELF with the latter simply being a submerged part of shield or platform. Close up of central Pacific Basin. Shows how the Hawaiian Islands (Hawaii marked with white arrow) are the youngest portion of a long chain of seamounts. The linear arrangement of many seamounts indicates that they formed because the plate moved over a stationary site of magma upwelling, a so called mantle "Hot Spot". Seamounts are submarine volcanoes that may finally build above the water level (e.g. Hawaii), in which case they are called islands. If seamounts rise above sea level (rises for two reasons, buildup of material in a cone, upwelling mantle pushes up plate), they are subject to wave erosion and colonization by reefs, with both processes tending





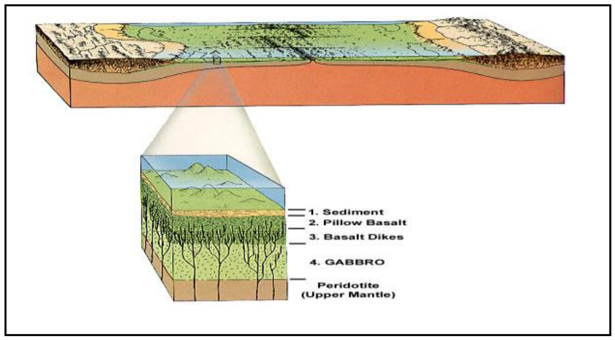


to create a flat top on the original volcanic cone. Later, when the oceanic plate cools down and the island finally drowns we get flat-topped seamounts, so called GUYOTS. Close up of the eastern Pacific Basin. Shows triple junction of spreading ridges in center. Also shown are the subduction zone/trench along the western edge of Central America, and the associated slope and shelf regions. The trenches are the deepest parts of the oceans and are the topographic expression of subduction zones. They are marked by intense volcanism (island arcs, volcanic mountain ranges, e.g. Andes, Cascades), and high frequency of earthquakes. They are usually asymmetrical with a gentle slope towards the subducted plate, and a steeper

slope towards the subducting plate. Some trenches are as deep as 11 km, and may extend for thousands of kilometers across the seafloor. A map of the ocean basins where the locations of some major deep sea fans are marked. Deep Sea Fans are large sediment accumulations that are deposited on the slope and the adjacent seafloor. The sediments are supplied to the slope regions through submarine canyons , deep incisions in the continental shelf that probably originated during prior episodes of low sea level (ice ages). Along the continental margins sediment that is conveyed to the deep sea via submarine canyons (sliding, mass movement, turbidity currents) forms large cone-shaped or fan-shaped sediment accumulations at the toe of the continental slope, so called SUBMARINE FANS or DEEP-SEA FANS (not unlike alluvial fans). Turbidity currents move down these fans, spread out on the abyssal plain, decelerate, and deposit graded sand and silt layers (so called turbidities sequences). Sediment spreading by turbidity currents helps to smoothern the relief in abyssal plain regions. The floor of the ocean basins (abyssal plains) is essentially basaltic crust that is covered by sediment (settling from suspension, of organic material such as foram tests, radiolarian tests, etc., and also clay swept in from the rivers, volcanic ash [large ash clouds may circle the globe several times], and material transported by winds from the continents [Atlantic west of Sahara desert]). We call that material PELAGIC SEDIMENT.

YOU MAY SAW THE OCEAN BUT DO YOU HAVE IDEA ABOUT THE CRUST?

The oceanic crust is not simply a pile of basalt, but can be subdivided into several distinct layers, that form in response to the processes operating at a mid oceanic ridge. The top layer (1.) consists of pelagic sediments that were deposited above the basalts of the oceanic crust. The second layer (2.) consists of lavas that were extruded onto the ocean floor at the spreading center. These lavas are called pillow basalts, because of the way they appear in cross-section. The molten basalt is extruded onto the ocean floor through fractures (extension), and as soon as the molten material comes in contact with seawater it will cool down and solidify. The next batch of lava will come out to the side of the first one, and also will solidify, etc. We will slowly pile up small batches of magma, that in their geometric arrangement are not unlike a pile of sausages, or squirts out of a toothpaste tube. In cross section we will have mainly elliptical cross- sections (pillow shape), thus the name pillow basalt. The surface topography of this layer is irregular and rough. The third layer (3.) consists essentially of complexly cross-cutting, near vertical basaltic dikes, which are the feeder channels for the pillow basalts. They form as fractures at the spreading center (highest extensional stress), and finally fill up with basalt and become part of the sheeted dike complex as they move away from the spreading center. The fourth layer (4.) consists of the magma chambers that feed the dikes of layer three, and these leftover magma chambers are filled by the plutonic equivalent of basalt, gabbro. The magma itself originated by partial melting in the mantle below the spreading center (higher heat flow, rising of accumulating melt). Below that layer is the mantle (asthenosphere), consisting of peridotite. That the oceanic crust is layered has been known from seismic refraction data, but nobody has ever drilled through the oceanic crust (too hot). Fortunately, once in a while bits and pieces of oceanic crust are incorporated into the uplifted material of flooded mountain belts, and is thus available for direct and detailed study. In Iceland, where the Mid-Atlantic Ridge rises above the sea surface, is another opportunity to examine the structure of the oceanic crust. As new oceanic crust forms at mid-oceanic ridges, cold sea water invades the hot new crust through the abundant fractures (crustal extension). As the sea water heats up its density decreases and it rises upwards. When it leaves through fractures at the seafloor we have submarine hot springs, better known as black smokers. These hot springs have created quite a bit of excitement in the scientific community because they open up all sorts of unexpected angles on the chemistry of the oceans, the transfer of chemical elements between the oceans and the oceanic crust (elemental cycles), and the origin of life . The latter was prompted by the discovery of unusual communities of microbes, worms, clams, and crustaceans that live at hot spring sites and instead of sunlight depend on energy supplied by the hot springs in the form of sulfides.



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DO YOU KNOW THE AGE OF THE EARTH?

Here's what science has to say: For millennia , humans assumed that the Earth was about as old as we were. In Roman times , theorists guessed that Earth started around the time of the Trojan war — the earliest event in their historical record. The "begats" in the Bible were another source for estimates : In the 17 th century , Ireland 's Archbishop James Ussher reconstructed the genealogy of biblical figures and declared that Earth was created at 6 p. m. on Oct . 26 , 4004 B. C. Those dating methodologies didn ' t hold up to modern science , as it eventually became clear that the birth of our planet far predates the origin of humankind. Scientists now know the Earth is actually 4 . 54 billion years old , an age built on many lines of evidence from the geologic record.

The modern effort to understand the age of the planet started with Nicholas Steno, a Danish anatomist and geologist who was among the first to realize that fossils are the remains of living creatures. He proposed that geologists might learn about Earth's history by sifting through layers of rock, which were laid down over the course of millennia and provide a backward chronology of our planet.

A century later , William Smith realized that rock layers at distant locations came from the same time period . He created a catalogue of strata (which all got colorful names such as Lias Blue, and Ditto White) and argued that each one represented a distinct time in Earth' s history — a principle known as fossil succession.

The accumulating evidence pointed to an extraordinary new idea: that the history of Earth goes back much , much further than any human memory . In 1788, Scottish geologist James Hutton published his “Theory of Earth,” which introduced the world to the idea of “ deep time . ” The implications of the treatise were revolutionary : Not only was the Earth not young , but it was not static , Hutton said . The same geologic forces that operate today, like deposition, erosion and uplift, have been shaping the Earth for ages with “no vestige of a beginning , no prospect of an end. ”

Science provided a new way of thinking about Earth' s history ; it made the distant past knowable . Rather than assume the planet was the product of bygone catastrophes , such as a massive global flood , scientists could explain the ancient rock record with phenomena that exist today. This spawned several earnest — if not entirely successful — attempts to determine the age of the Earth based on ongoing natural processes . One calculated how long it would take rivers to deliver enough dissolved minerals to the ocean to give it its current saltiness (answer: 90 million to 100 million years). Others looked at the average rate of sedimentation and concluded it would take anywhere from 3 million to 1 . 6 billion years for the rock record to reach its currentthickness. But the big breakthrough came with the invention of radiometric dating. Shortly after radioactivity was discovered in 1896 , scientists realized they could figure out how old a rock was by measuring how much of the uranium in it had decayed into lead . Here’s how that works: The nuclei of radioactive elements decay — or spontaneously break down — at predictable rates . For example , half of a given batch of uranium will decay into lead every 710 million to 4 . 47 billion years , depending on the isotope used (this number is termed the element' s “ half - life ") . That uranium, which was created during a supernova that occurred long before our solar system existed , lingers in trace amounts within the Earth . When a rock is formed in the bowels of the planet , uranium atoms are trapped within it. These atoms will decay as the rock ages , and by measuring the ratio of radioactive isotopes within the rock , scientists can figure out how long it has been around . In 1913 , geologist Arthur Holmes published “ the Age of the Earth, ” the first major effort to date the planet using radiometric dating . “ It is perhaps a little indelicate to ask of our Mother Earth her age , ” he wrote in his introduction — then proceeded to reveal that she was roughly 1 . 6 billion years old When Holmes presented the findings at a meeting of the Geological Society of London two years later , he was “violently attacked ” by critics . “ I found myself an exasperated minority of one , ” he would later recall. But time would prove him right . By the 1940 s , the geology community had mostly accepted his revised estimate of about 4 . 5 billion years — a number not far from the one we use today . Modern geologists date minerals called zircons , tiny crystals that form in volcanic eruptions and that are hardy enough to survive for billions of years . Zircons consist of silica, oxygen and the element zirconium , but are occasionally contaminated with uranium as they form . Because of the structure of the crystals, zircons never include lead when they are forged inside the Earth. This makes them, as this University of California at Berkeley webpage put it , “nearly perfect clocks . ” Any lead that scientists find in the crystals must come from radioactive decay . To do this , scientists use a technique called mass spectrometry . Put simply , they fire a laser at the zircons , which excites the atoms within them. Then they separate the emitted light into its component parts (a spectrum), so they can detect the signatures of particular elements . But even the oldest zircons are not as old as the Earth itself . Everything on our world eventually is eroded or subsumed back into the crust . To get a truly precise date for the origin of our planet , scientists have to look beyond it. Meteorites offer exactly what they need . The asteroids that meteorites come from are some of the most primitive objects in the solar system . They were formed at the same time as our planet and everything else in our solar system , but they have not been changed by the tectonic processes that shape Earth, so they 're like timecapsules. Our first really solid estimate of the planet 's age was obtained from radiometric analysis of the Canyon Diablo meteorite , a giant iron rock that blazed through Earth' s atmosphere from space 50 , 000 years ago and was found by American scientists in 1891 . Native Americans had known about and utilized the iron fragments since prehistoric times Researchers used uranium-lead techniques to date the meteorite back 4 . 54 billion years , give or take about 70 million — the best age for our planet so far , according to the U. S . Geological Survey. But scientists will keep trying to shave down that degree of uncertainty in their estimate by analyzing every ancient Earth rock , meteorite and solar system sample they can get their hands on . As the U.S . Geological Survey explains: " The best age for the Earth comes not from dating individual rocks but by considering the Earth and meteorites as part of the same evolving system . "

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KEEP OCEAN CLEAN AND MAKE IT ECOFRIENDLY

1. Mind Your Carbon Footprint and Reduce Energy Consumption

Reduce the effects of climate change on the ocean by leaving the car at home when you can and being conscious of your energy use at home and work. A few things you can do to get started today: Switch to compact fluorescent light bulbs, take the stairs, and bundle up or use a fan to avoid oversetting your thermostat.

2. Make Safe, Sustainable Seafood Choices

Global fish populations are rapidly being depleted due to demand, loss of habitat, and unsustainable fishing practices. When shopping or dining out, help reduce the demand for overexploited species by choosing seafood that is both healthful and sustainable.

3. Use Fewer Plastic Products

Plastics that end up as ocean debris contribute to habitat destruction and entangle and kill tens of thousands of marine animals each year. To limit your impact, carry a reusable water bottle, store food in non disposable containers, bring your own cloth tote or other reusable bag when shopping, and recycle whenever possible.

4. Help Take Care of the Beach

Whether you enjoy diving, surfing, or relaxing on the beach, always clean up after yourself. Explore and appreciate the ocean without interfering with wildlife or removing rocks and coral. Go even further by encouraging others to respect the marine environment or by participating in local beach cleanups.

5. Don't Purchase Items That Exploit Marine Life

Certain products contribute to the harming of fragile coral reefs and marine populations. Avoid purchasing items such as coral jewelry, tortoiseshell hair accessories (made from hawksbill turtles), and shark products.

6. Be an Ocean-Friendly Pet Owner

Read pet food labels and consider seafood sustainability when choosing a diet for your pet. Never flush cat litter, which can contain pathogens harmful to marine life. Avoid stocking your aquarium with wild-caught saltwater fish, and never release any aquarium fish into the ocean or other bodies of water, a practice that can introduce non-native species harmful to the existing ecosystem.

7. Support Organizations Working to Protect the Ocean

Many institutes and organizations are fighting to protect ocean habitats and marine wildlife. Find a national organization and consider giving financial support or volunteering for hands-on work or advocacy. If you

8. Influence Change in Your Community

Research the ocean policies of public officials before you vote or contact your local representatives to let them know you support marine conservation projects. Consider patronizing restaurants and grocery stores that offer only sustainable seafood, and speak up about your concerns if you spot a threatened species on the menu or at the seafood counter.

9. Travel the Ocean Responsibly

Practice responsible boating, kayaking, and other recreational live near the coast, join up with a local branch or group and get involved in projects close to home. activities on the water. Never throw anything overboard, and be aware of marine life in the waters around you. If you’re set on taking a cruise for your next vacation, do some research to find the most eco-friendly option.

10. Educate Yourself About Oceans and Marine Life

All life on Earth is connected to the ocean and its inhabitants. The more you learn about the issues facing this vital system, the more you'll want to help ensure its health—then share that knowledge to educate and inspire others.

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SCIENTIFIC QUIZ

1. **Question:** What is the local name or Tamil name of *Acanthus ilicifolius*:

Ans: kaluthaimulli

2. **Question:** What is the local or tamil name for *Exoecaria agallocha*:

Ans: Thillai maram

3. **Question:** What are mangroves?

Ans: Mangroves are group of woody plans found in between land and sea i.e. kalimugathuvaram

4. **Question:** Examples of mangrove plants :

Ans: *Acanthus illicifolius, Exoecaria agallocha*

5. **Question:** Examples of special adoptaation?

Ans:*Rhizophora* (in tamil surapunnai), *Avicennia* (in tamil kandal maram)

6. **Question:** Distribution of mangroves in India:

Ans: Tamil nadu: Pichavaram; Westbengal: Sunderban; Gujarat: Bhitarkanika; Kerela: Kannoor

7. **Question:** Uses of mangroves:

Ans: Fodder, firewood; charcoal, honey collection, tourism, medicines for diarrhea, vomiting, arthiritis, malaria, liver damage etc.

8. **Question:** Environmental uses:

Ans: Absorbs more UV light, release more oxygen, absorbs more carnbondioxide

9. **Question:** Special adaptation of mangroves:

Ans: Stilt root for eg. *Rhizophora*, respiratory root for eg. *Avicennia*, viviparous germination (seeds germinated inside the fruit itself)

10. **Question**: What is chromatography;

Ans: Characterization of chemical compounds based on colors

11. **Question**: Principles of chromatography:

Ans: Rf. Resolution front; Stationary phase- silica gel, Mobile Phase- liquid or gas

12. **Question**: What is NMR:

Ans Nuclear Magnetic Resonance?

13. **Question**: What is FT-IR?

Ans: Fourier Transform Infra Red

14. **Question**: What is the name of the compounds identified in the *Exoecaria agallocha*?

Ans: diterpene and 3, 4, 5-trihydroxy benzoate

15. **Question**: What is the name of the compounds identified in the *Acanthus ilicifolius*?

Ans: 3, 5-dimethyl- 4-hydroxy benzoate

16. **Question**: Why the phytochemistries in mangroves are important?

Ans: Mangroves are unexplored in chemical characterization.

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