The Deep Sea
COVID VERSION

The Deep Sea

- The deep sea is the part of the marine environment that lies below the level of effective light penetration for phytoplankton photosynthesis in the open ocean and deeper than the depth of the continental shelves (>200m).

Pressure

- In the ocean, pressure increases 1 atmosphere for each 10 m in depth. This leads to a pressure of more than 1,000 atm in the Mariana Trench. Organisms that live under great pressure employ a number of adaptations including lack of air-filled organs, lower metabolic rates and decreased shell-forming.

Temperature

- The greatest and most rapid changes in temperature occur where the surface waters meet the deep waters (the thermocline) and where hydrothermal vents emit hot water as high as 400^{o}C.

Oxygen

- Virtually all the water of the deep sea has its origin at the surface in the Arctic or Antarctic seas. Here, the oxygen-rich cold water sinks and flows north or south to make up the deep water of the world's oceans.
- At a depth of 500 to 1,000 meters, the oxygen minimum zone is found. This is an area of lower oxygen levels, caused by respiration of organisms coupled with the lack of interchange that occurs at the surface.

Food

- The deep sea is removed from the photosynthetic zone and has no primary production except for the chemosynthesis. Food is therefore a scarce resource, originating primarily from organic material that falls down through the deep sea.

Biological Characteristics of Deep-Sea Organisms

- Ecological: low mortality due to low predation pressure, low population densities and slow, indeterminate growth.
- Reproduction: late reproductive maturity, few large, yolk-rich eggs and slow embryological development.
- Physiological: low metabolic rate, high water content and small size

Abyssal Plain

- The Abyssal Plain is the largest ocean ecosystem. This flat, sediment covered area is rich in organic material that has floated down from above as marine snow. The abyssal plain is dominated by echinoderms and arthropods, which scour the ocean floor for detritus.

Mid-Ocean Ridge

- The Mid-Ocean Ridge system are the largest mountain chains on Earth. They are geologically important because they occur at divergent plate boundaries where new ocean floor is created through volcanic activity. This volcanic activity also gives rise to another important ecosystem, the hydrothermal vent.

Hydrothermal Vents

- All vent systems depend on the primary productivity of chemolithoautotrophic (chemosynthetic) bacteria that form organic compounds from hydrogen sulfide (H_2S). Organisms of the hydrothermal vent are adapted to high water temperature, and typically have short life spans.

Methane Seep

- Methane Seeps are the cold water cousins of the hydrothermal vent. The base of the food chain is also dependent on chemosynthesis, but the bacteria are feeding on CH_4 instead of H_2S. Due to the colder temperatures, organisms here are often long lived. Polychaete worms at a methane seep can live several hundred years, compared to those at hydrothermal vents that may live only a few years.

Marine Organisms of the Day

1. Pacific Barreleye Fish (*Micropinna microstoma*): This fish has eyes that can look upwards as well as forwards. Their organs glow due to the presence of symbiotic bioluminescent bacteria. To avoid detection, the fish uses counterillumination, which uses light to break up the fishes' silhouettes so that when they are viewed from above, they blend in with the ambient light from the surface.
https://www.youtube.com/watch?v=Zoygy-8PTtU (1:57)

2. Frilled Shark (*Chlamydoselachus anguineus*): The Frilled Shark exhibits characteristics of more ancient fish. No one has ever seen a frilled shark feeding, but it is known to be an ambush predator. It gets its name from its six pairs of collar-like gills with frilly edges.
https://www.youtube.com/watch?v=qYH32gKMHuc (1:14)

3. Fangtooth fish (*Anoplogaster cornuta* and *Anoplogaster brachycera*): Fangtooths are named for their very large teeth compared to body size (the fish only grows to about 6 inches long). The largest teeth actually fit into special sheaths on either side of its brain so it can shut its mouth.
https://www.youtube.com/watch?v=_lOwi6upg4I (2:10)

4. Hairy Anglerfish (*Caulophryne polynema*): The Hairy Anglerfish is one of over 200 species of anglerfish, all of which are known for the bioluminescent lure that females have to attract prey. Males are much smaller and lack the lure. The Hairy Anglerfish is covered in sensory filaments to detect motion around it.
https://www.youtube.com/watch?v=AW93uB5fDLQ (4:37)

5. Vampire Squid (*Vampyroteuthis infernalis*): The scientific name of the vampire squid literally means “Vampire Squid of Hell”, though it is only six inches long and feeds primarily on floating detritus. The vampire squid does not have an ink sac, but can eject a bioluminescent mucus when disturbed.
https://www.youtube.com/watch?v=G4U0vG2bxy0 (4:11)

6. Giant Squid (*Architeuthis dux*): The species that gave rise to the mythological kraken, the Giant Squid grow to about 45 feet long. It was only first filmed in its natural habitat in 2012, although that specimen was only 24 feet long. And here is that video!
https://www.youtube.com/watch?v=jCWop491Q9Y (2:31)

Finding Nemo Clips for This Exam

11 – Anglerfish End Credit