

Physical and Chemical Oceanography

COVID VERSION

The Oceans

- The world ocean is separated into four major divisions: Pacific, Atlantic, Indian, and Arctic. 80% of the southern hemisphere is covered in ocean and 61% of the northern hemisphere is covered in ocean.

Water

- Water has several properties that make life as we know it possible. These include high surface tension, high conduction of heat, low viscosity and being a universal solvent
- Seawater is 96.5% pure water. The other 3.5% comes from the dissolved solids that rivers carry to oceans.
 - The total amount of dissolved material in water is its salinity. The global average is 34.7 ppt. The major dissolved solids in seawater are Chloride (55%), Sodium (31%), Sulfate (8%) and Magnesium (4%)
- An important tool for oceanographers to study water is a CTD, which measures conductivity, temperature, and depth. Other instruments can be attached, such as a Niskin bottle (collects water at different depths).

Marine Biomes

- Saltwater oceans cover about 71% of the earth's surface. They are essential for regulating global temperature and climate. There are two major marine zones:
 - The neritic zone is the warm, nutrient rich water extending to the edge of the continental shelf, containing 90% of all marine species
 - The oceanic zone includes all waters beyond the continental shelf.

Nautical Charts

- While maps primarily represent land, charts depict water-related information. A nautical chart is primarily concerned with navigable water areas and includes coastlines, harbors, obstructions, currents, and depth.

Bathymetry

- Bathymetry is the measurement of ocean depths and the charting of the shape or topography of the ocean floor
- Early methods of determining ocean depths involved using a long weighted line called a sounding line. Now we use SONAR (Sound Navigation and Ranging).

Ocean Geomorphology

- The underwater extension of a continent is the continental shelf .
- At the outer edge of the shelf, there is an abrupt steepening of the bottom to become the continental slope.
- The deep, flat, sediment covered bottom of the ocean is the abyssal plain. In some areas, the abyssal plain is broken by deep troughs called trenches or isolated underwater mountains called seamounts.

Ocean Currents and Waves

- Waters of the ocean move in giant streams called currents. Surface currents are driven by wind, while deep currents are driven by density differences.
 - The Coriolis Effect is the deflection of the earth's winds and currents by the earth's rotation, causing huge circles of moving water called gyres
- Waves are periodic up and down movements of water that transfer energy. Wave size is determined by wind speed, length of time wind blows, and fetch (distance wind blows)

Tides

- The periodic predictable rise and fall of the level of the sea over time is called a tide. Tides occur due to the gravitational attraction of the sun and moon and the centripetal force generated by the rotating earth-moon system.
- Locations having a single low tide and high tide per day are said to experience diurnal tides. Those with two highs and two lows per day experience semidiurnal tides. Those having a mixture of diurnal and semidiurnal tides experience mixed tides.
- The difference between levels of high tide and levels of low tide is the tidal range. Spring tides occur when there is a new moon or full moon and are large. Neap tides occur during first and third quarter moon phases and are smaller than normal

Marine Organisms of the Day

- 1. (Nemo) Clown Anemonefish aka False Percula Clownfish aka Common Clownfish (*Amphiprion ocellaris*):** Clownfish are sequential hermaphrodites, which mean that they develop into males first, and then when they mature, they become females. The clownfish is able to survive the anemone poison through a mucus coating based on sugars instead of protein so that the anemone doesn't recognize it as food and fire its nematocytes.
<https://www.youtube.com/watch?v=P-5ezc-2uD4> (1:28)
- 2. (Crush) Green Sea Turtle (*Chelonia mydas*):** The Green Sea Turtle is the largest of the sea turtles at up to 700 lbs. Unlike most sea turtles, adult Green Sea Turtles are almost exclusively herbivorous, while juveniles will eat invertebrates like jellyfish and crabs.
<http://oceantoday.noaa.gov/endoceanseaturtles/> (2:49)
- 3. (Bloat) Spotted Porcupinefish (*Diodon hystrix*):** While porcupinefishes are sometimes referred to as pufferfish, they are actually in the family Diodontidae along with burrfishes, while the true pufferfishes are in the family Tetraodontidae). All these species are known for dramatically increasing their size by taking in air or water. In Porcupinefish, this results in the extension of sharp spines. Some species are also poisonous, accumulating toxins in their internal organisms from bacteria in their diet.
<https://www.youtube.com/watch?v=dBXhZACiT8Q> (1:49)
- 4. (Pearl) Pink Flapjack Octopus (*Opisthoteuthis californiana*):** The Pink Flapjack Octopus is actually a deep water octopus, living in depths of 500-1,500 m. Sadly, Pearl would not be able to survive in the surface waters of the Great Barrier Reef.
<https://www.youtube.com/watch?v=aqQO8smcDzs> (0:38)
- 5. (Gil) Moorish Idol (*Zanclus cornutus*):** The Moorish Idol is the only living species of their family (Zanclidae). They are native to Pacific and Indian Ocean coral reef ecosystems, and are famous for being extremely difficult to keep in aquariums – P. Sherman must be a very accomplished aquarist.
<https://www.youtube.com/watch?v=Nqfi-LOnImc> (1:12)
- 6. (Gurgle) Royal Gramma (*Gramma loreto*):** The Royal Gramma is a common reef fish that feeds primarily on plankton, but has been known to clean parasites off other fish. They are a peaceful fish that is often kept in aquariums for that reason.
<https://www.youtube.com/watch?v=US19qP5xTk4> (2:22)
- 7. (Sheldon) Queensland Seahorse (*Hippocampus queenslandicus*):** Seahorses inhabit bottom rubble and seagrasses, feeding on plankton and small crustaceans. As with all seahorses, the male brood the eggs in a pouch until hatching.
<https://www.youtube.com/watch?v=yOt1BSy0KdY> (2:24)
- 8. (Dory) Regal Tang aka Royal Blue Tang (*Paracanthurus hepatus*):** Blue tangs can make themselves semi-transparent when faced with danger to help them escape. It is used as a bait fish, but is more highly prized as an aquarium fish. It also may cause ciguatera (symptoms: gastrointestinal and neurological affects that can last for years) poisoning if eaten by humans.
<https://www.youtube.com/watch?v=5IvKtfxSeKc> (2:15)
- 9. (Mr. Ray) Spotted Eagle Ray (*Aetobatus narinari*):** The spotted eagle ray is a “near-threatened” species due to overharvesting that lives in shallow inshore waters and along coral reefs. They have been known to leap out of the water, possibly to escape predators, surprise prey, remove parasites or attract mates.
https://www.youtube.com/watch?v=4L1Zm_HOBTQ (1:36)

Finding Nemo Clips for This Exam

5 – The Drop Off

16 – Sea Turtles

31 – Tank Escape