# SECTION 1: Marine Biology

## The Oceans

- Oceans cover 71% of Earth's surface.
- Deepest point is approximately 11,000 m, with an average depth of 3,800 m.
- Oceans provide 300 times more space for life than land and freshwater combined.
- Formed approximately 4,400–3,500 million years ago.
- More phyla are found in the sea than on land or in freshwater, with most marine species still undescribed.

Life evolved in the sea, despite the harsh conditions.

Reasons:

- Most of Earth's water is found in the oceans.
- Many phyla live in saltwater environments.

**Favourable attributes**

- Seawater is denser than air, allowing marine organisms to be supported by water without needing large skeletons.
- Floating and swimming require relatively little energy.
- Ocean temperatures are generally very stable.

**Unfavourable attributes**

- Plant growth is limited to upper waters due to light penetration.
- Plant growth is limited by essential nutrients. Decaying matter sinks to the seafloor, and nutrients can only return to upper waters through water movement.
- Hydrostatic pressure increases with depth, contributing to vertical zonation.
- Geographic barriers are created by physical differences (temperature) and chemical differences (salinity) in seawater.

**Main abiotic factors that govern marine life:**

- Light
- Temperature
- Salinity
- Water movement

- Nutrients
- Depth (hydrostatic pressure)
- Chemical composition

**Light (solar radiation)**

Light → Plants → Conversion to organic matter

Light → Water → Heat → Temperature regimes

- Light penetration controls the maximum depth distribution of plants and some animals.
- Deepest recorded seaweed occurs at approximately 268 m.
- The clearer the water, the deeper light can penetrate.

**Ecological zones defined by light penetration**

**Euphotic zone:** Sufficient light to support plant growth and photosynthesis.

**Disphotic zone:** Fish and some invertebrates can see, but there is insufficient light for positive net photosynthesis.

**Aphotic zone:** Sunlight cannot be detected by any biological system. No plant life occurs, and organisms are spatially separated from the initial link in the food chain.

**Light, depth and algal distribution**

Algae: Chlorophyta (green algae), Phaeophyta (brown algae), Rhodophyta (red algae).

Some algae have adapted through:

- Changes in algal form and growth rates.
- Changes in pigment concentration.

**Photosynthetic responses**

**Non-photosynthetic responses**

- Phototropism (taxis)
- Reproductive cues (day length and blue light)

**Causes of light attenuation**

- **Inland waters:** Gilvin, particulates or a combination of both.
- **Estuaries:** Inorganic particles.

- **Coastal waters:** Phytoplankton and inorganic suspended particulate matter (SPM).
- **Open ocean:** Phytoplankton and water.

**Temperature**

- Controls the rates of chemical reactions and biological processes.
- Temperature and salinity combine to determine seawater density.
- Temperature partly determines the concentration of dissolved gases.
- Isotherms (lines of equal temperature) set distribution boundaries for species and communities.
- Temperature varies with latitude.
- Thermocline: A layer where temperature changes rapidly with depth.

**Salinity**

- Maintaining osmotic balance is challenging and physiologically costly for marine organisms.
- Halocline: A layer where salinity changes rapidly with depth.

**Water movement (currents)**

**Energy from the sun**

- Radiation balance is positive at low latitudes and negative at high latitudes.
- Heat is redistributed to higher latitudes by winds and ocean currents.

**Rotation of Earth**

- Friction between the ocean and Earth is weak.
- Coriolis force is strong, being zero at the equator and maximum at the poles.

**Tides**

- Caused by the gravitational pull of the Moon.

**Environment (organism relationships)**

**Surge zone**

Physical challenge – Mechanical drag caused by water movement.

Adaptation – Leathery, flexible structures.

The shape, size, colour, behaviour and other characteristics of organisms depend on the environment in which they live and their place within the ecosystem.

**Essential strategies for all organisms:**

- Obtain or produce food.
- Avoid being eaten.
- Reproduce.

Meeting these requirements determines where organisms live and how they obtain nutrition.