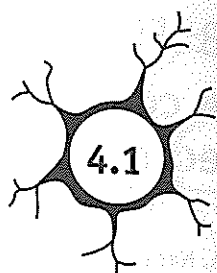


## 4 PLANT AND ANIMAL ADAPTATIONS

### A comparison of characteristics of the aquatic and terrestrial environments



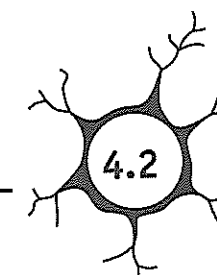
Any organism living in a terrestrial environment faces a physical environment very different from that experienced by an aquatic organism. The differences in the physical factors affect the chances of survival of aquatic and terrestrial organisms. A difference in a physical factor can present an **environmental problem** to which organisms have developed **adaptive solutions** (called 'adaptations') over millions of years of **natural selection** and **evolution**.

Physical characteristic	Aquatic environment	Terrestrial environment
1. <i>Viscosity</i> Refers to the 'stickiness' of the medium through which organisms need to move	Water has high viscosity compared to air	Air is less viscous than water
2. <i>Buoyancy</i>	Water provides an upthrust (flotation), providing support for soft body tissues	Air provides little flotation support compared to water. Organisms cannot rely on air for soft tissue support
3. <i>Temperature variation</i>	Large bodies of water (e.g. oceans, lakes) show little temperature variation compared to air temperatures on land. Water temperature decreases with increasing depth	In air, wide temperature variations occur. Air temperature decreases with increases in altitude and towards the poles
4. <i>Heat loss</i>	Water is a <b>conductor of heat</b> compared to air. A warm body will lose heat more rapidly in water than in air	Air is a <b>heat insulator</b> compared to water. The same warm body will tend to lose heat more slowly in air than in water
5. <i>Availability of gases</i>	Oxygen availability in water (at 20°C) is less than 1%. O <sub>2</sub> and CO <sub>2</sub> content of water decreases with increases in water temperature and with increasing depth	21% of the air is oxygen which remains constant with temperature variations but decreases with altitude. There is rapid diffusion of gases in air
6. <i>Availability of water and ions</i>	Water and dissolved mineral ions are readily available to organisms	Water availability varies greatly as does availability of ions in soil water of fertile to poor soils
7. <i>Light penetration</i>	Light intensity decreases with depth. Light quality (wavelengths available) also decreases with depth	Light intensity and quality are uniformly available
8. <i>Pressure</i>	Water pressure increases with depth and places great stresses on organisms	Air pressure increases with decrease in altitude but does not exert the same severe forces as water pressure

- 1 For each of the physical characteristics (1–8) above, briefly outline:
- the environment (aquatic or terrestrial) in which the physical characteristic presents itself as a **problem**;
  - the nature of the **problem** to a living organism; and
  - an example of the type of **adaptive solution** to the environmental problem.

## 4 PLANT AND ANIMAL ADAPTATIONS

### Support



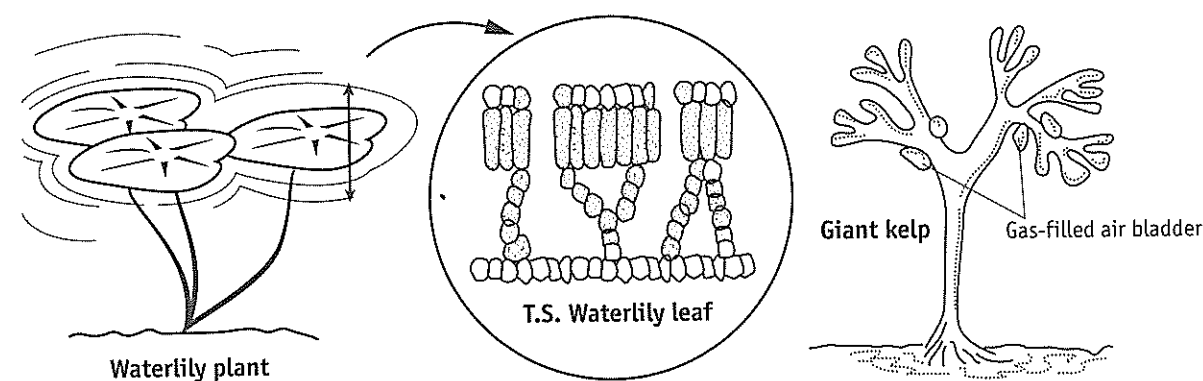
#### A. Support in the aquatic environment

##### Plants living in water

Plants living in water are the **true algae** and a relatively small number of **Bryophytes** (mosses, liverworts), **ferns** and **flowering plants**. For support in water, plants rely upon:

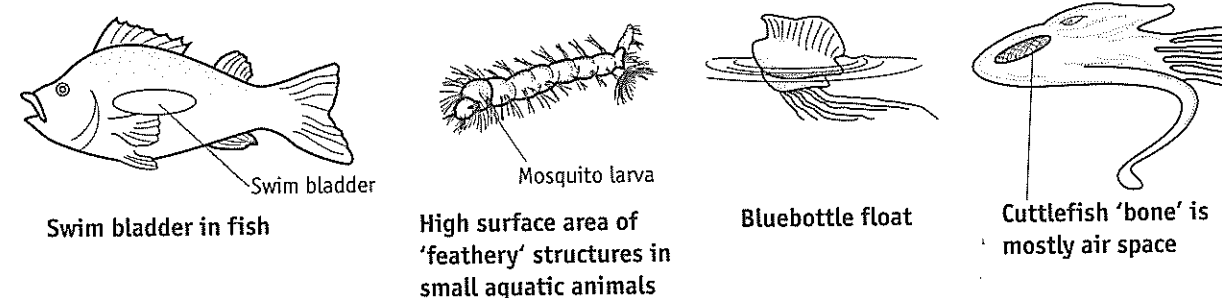
- the buoyancy (**uplifting**) effect of water; and
- air chambers** and **gas-filled bladders**.

This buoyancy ensures that the plants' photosynthetic tissues have maximum surface area exposed to light, dissolved CO<sub>2</sub> and dissolved minerals.



##### Animals living in water

Animals living in water also gain support from the buoyancy effect of water and thus generally do not require extensive skeletal systems; however, swim bladders and various flotation adaptations are used by aquatic animals.



- The type of **structural supporting tissue** found in land plants is not present in the true water plants (the algae) and is reduced in other types of water plants. Explain this trend.
- The main supporting tissue in land plants is derived from **vascular tissue** (especially the **xylem**). For algae, this xylem vascular tissue need not be developed. Provide two reasons to account for this.
- The buoyancy effect of water ensures that the **maximum organism surface area** is exposed to the environment. How is this advantageous to **aquatic plants**?
- List two features of the **waterlily leaf cross-section** and explain their importance as adaptations to the **aquatic environment**.
- Aquatic animals use buoyancy devices to maintain or adjust their position in a **preferred section of the aquatic environment** (i.e. at the surface or at various depths). What features of the aquatic environment may change to make this adjustment necessary?