IB BIOLOGY | B4.1 | SL

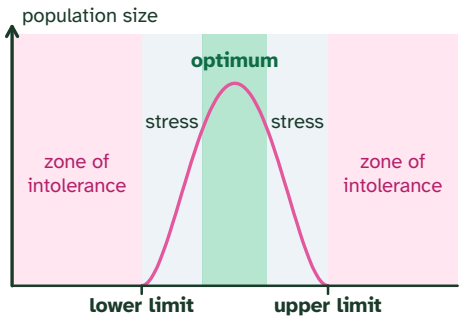
REVISION ON TWO PAGES

Each species in its *place*

What to know, what to draw and what to say. Nothing else.

THE ONE IDEA

Abiotic conditions decide where a species can live. Its adaptations set its range of tolerance; on land, climate sets the biome.



Draw it like this. A hump that reaches zero at the lower and upper limits.

B4.1.3, B4.1.4 START HERE

Abiotic variables and the *range of tolerance*

- Where a species is found depends on **abiotic variables**, for plants and animals alike.
- Each species copes with a set span of each variable: its **range of tolerance**. Its **adaptations decide where the limits fall**.
- **Optimum:** the population is largest. **Zones of stress:** individuals survive but grow and reproduce less. **Zones of intolerance:** beyond the limits, it cannot survive.
- A **limiting factor** is the one that sets the edge of a species' distribution.

Plants abiotic variables
Light, temperature, water, soil pH, minerals, salinity and wind.

Animals abiotic variables
Temperature, water, oxygen (in water especially), salinity and shelter.

B4.1.1

A *habitat*

- A habitat is the **place where an organism lives**. The word fits any level: one organism, a population, a species or a community.
- Each habitat has its own abiotic conditions. A **full description** gives three things, here for marram grass:

1 Location on the map
Coasts of north-west Europe.

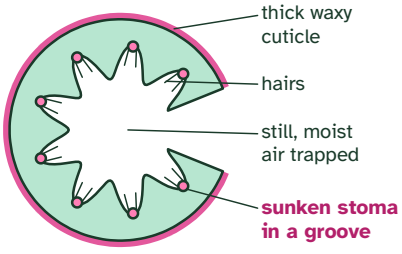
2 Physical conditions
Loose sand, salt spray, wind.

3 Type of ecosystem
Sand dunes.

B4.1.2 SAND DUNES

Marram grass

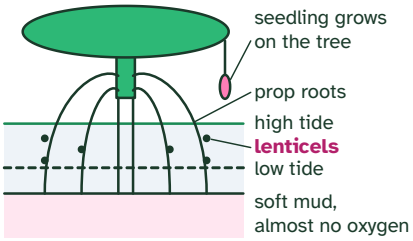
- *Ammophila arenaria*, on dunes where the sand is **dry, salty and blowing**.
- In dry weather the **leaf rolls up**, so **sunken stomata** among hairs open into still, moist air: little water is lost.
- Roots reach metres down to water; **rhizomes** spread sideways. Buried by sand, it grows up through it.



B4.1.2 MANGROVE SWAMPS

Red mangrove

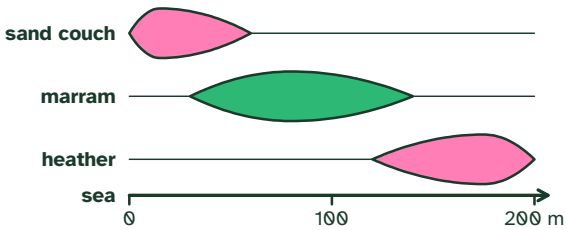
- *Rhizophora mangle*, between the tides on tropical coasts, over **salty mud with almost no oxygen**.
- Arching **prop roots** brace it; **lenticels** in them take in air when the tide is out.
- Roots **keep most salt out**; salt that gets in is stored in **old leaves, which are shed**. Seedlings grow on the tree.



B4.1.4 APPLICATION OF SKILLS

Correlate with a *transect*

- Collect your own data in a **natural or semi-natural habitat** (shaped by people, but wild species dominate).
- Lay a **line where conditions change**, such as a beach inland. At set intervals, place a **quadrat** and record each species.
- Measure abiotic factors there with **sensors**: a soil pH probe, a light meter, a temperature probe, an anemometer for wind.
- A **kite diagram** plots each species as a band whose width is its abundance. A transect shows **correlation, not cause**.

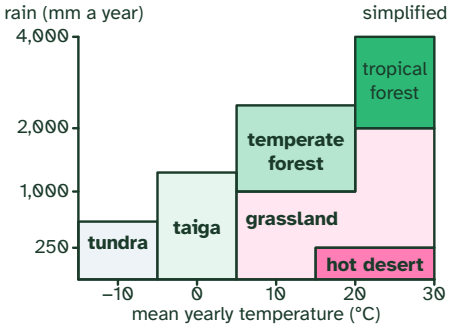


Sand couch tolerates the most salt; heather needs acid soil rich in humus.

B4.1.6, B4.1.7

Climate decides the *biome*

- On land, **temperature and rainfall** matter most: for any combination of the two, **one natural ecosystem type** is likely to develop.
- A biome: ecosystems with **similar communities**, as **similar abiotic conditions** select the same solutions (**convergent evolution**). **Cacti** (Americas) and **euphorbias** (Africa) are unrelated, yet both have pleated, water-storing stems and spines for leaves.



BIOME	CLIMATE
Tropical forest	Hot all year (about 25 to 28 °C); over 2,000 mm of rain.
Temperate forest	Mild, four seasons, rain all year; deciduous broadleaved trees.
Taiga	Long cold winters, short summers; conifers.
Grassland	Too dry for forest; hot summers, cold winters or a dry season.
Tundra	Very cold, a short cool summer, frozen ground; no trees.
Hot desert	Under about 250 mm of rain a year; hot days, cold nights.

B4.1.5

What a *coral reef* needs

- Coral polyps lay down **calcium carbonate** skeletons; **zooxanthellae** (algae in their cells) photosynthesise and **give most of the food**.
- **Acidification:** $CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$ (**pH falls**); $H^+ + CO_3^{2-} \rightarrow HCO_3^-$, so **fewer carbonate ions**: slower skeleton growth.

FIVE CONDITIONS FOR A REEF

D Depth: mostly under 50 m: light for the algae	**T** Temperature: warm, about 23 to 29 °C	**S** Salinity: full-strength sea water	**C** Clarity: little mud to block light	**P** pH: about 8.2, plenty of carbonate

B4.1.8

Too dry, too wet: *hot desert* and *rainforest*

	HOT DESERT *water is short, heat is high*	TROPICAL RAINFOREST *light is short, rain is heavy*
Plant	**Saguaro cactus *Carnegiea gigantea*** Pleated stem **stores water**; **spines** for leaves; wide shallow roots; **CAM**: stomata open only at night.	**Kapok tree *Ceiba pentandra*** Grows **above the canopy** into full sun; **buttress roots** in thin soil. Many leaves have a **drip tip**.
Animal	**Fennec fox *Vulpes zerda*** **Huge ears lose heat**; nocturnal, burrows by day; furred soles; **concentrated urine**.	**Three-toed sloth *Bradypus*** **Very slow metabolism** on leaves; curved claws to hang; **algae** in its fur hide it.

Either the common or the scientific name is accepted in an exam.

Saguaro: Sonoran Desert. Fennec fox: Sahara.

WATCH OUT

Five mistakes that *cost marks*

- ✕ **A transect shows correlation, not cause.** Wind, salt, pH and humus change together; an experiment finds the limit.
- ✕ **Stress is not intolerance.** Under stress a species survives but breeds less; beyond a limit it cannot survive.
- ✕ **A rolled marram leaf does not shut its stomata.** They open into moist air, so the vapour gradient is small.
- ✕ **CAM is not photosynthesis at night.** CO_2 taken in at night is used by day, stomata shut.
- ✕ **A biome needs both variables.** 12 °C with 500 mm of rain is grassland, not forest.

COVER THE SHEET

Can you *answer these?*

1. Outline the three things a full habitat description gives.
2. Explain one adaptation each of marram and mangrove.
3. State two abiotic variables each for plants and animals.
4. Draw a range of tolerance and label its zones.
5. Outline how a transect links a plant to soil pH.
6. Explain why coral reefs form only in shallow, clear water.
7. State the axes of a biome graph.
8. Explain why cacti and euphorbias look alike.
9. Explain two adaptations of a named desert animal.

IN THE EXAM

Name the species, the adaptation and the abiotic problem it solves: "the marram leaf rolls, so its sunken stomata open into still, moist air and **less water is lost**".

GO FURTHER

Animated figures, a dry lab and a marked Check are in the full guide online.