

1. **B:** Human erythrocytes are anucleate and biconcave, maximising surface area for rapid diffusion of O_2/CO_2 .
2. **B:** Cohesive hydrogen bonding creates surface tension strong enough to support the insect's mass.
3. **B:** Reduced area and thick cuticle minimise transpiration, adaptive in water-limited desert habitats.
4. **C** – Freeze-fracture splits the membrane through the hydrophobic core, exposing the internal faces of the bilayer. Integral proteins remain embedded and appear as raised particles on these faces, while peripheral proteins and glycolipids are usually removed with the fracture.
5. **C:** Niche combines functional role and environmental requirements—"address + profession".
6. **A** – Only companion cells remain fully living; they retain a nucleus and many mitochondria to provide ATP for loading and maintenance of the adjacent sieve-tube element. Xylem vessel elements are dead and hollow, while sieve-tube elements lose their nucleus and most mitochondria during maturation.
7. **C:** Oxidative phosphorylation at the inner mitochondrial membrane (cristae) generates the bulk of ATP.
8. **D:** Chlorophyll a is the primary photosynthetic pigment, with absorption peaks in the red (~660 nm) and blue (~430 nm) regions.
9. **A** – Reduced external humidity increases the water-vapour gradient. Rolling encloses stomata on the lower surface within a humid pocket, lowering the diffusion gradient and limiting water loss – a key xerophytic adaptation.
10. **B:** Species with identical resource requirements will out-compete one another until only one remains.
11. **C:** The Meselson–Stahl experiment demonstrated that replication produces hybrids with one original and one new strand.
12. **B:** Adenine forms two hydrogen bonds with thymine in DNA (uracil replaces thymine only in RNA).
13. **A** – Fungal hyphae extend the root's absorptive area and import solutes into root cortical cells, decreasing their water potential so water continues to move in osmotically even under drought conditions.
14. **B:** Habitat change altered the selective environment; banded shells now confer greater survival, increasing their frequency.
15. **A:** Complementary and antiparallel base-pairing yields mRNA codon 5'-AUG-3'.
16. **D:** Progressive increase in mean trait value with reduced variation indicates directional selection toward deeper beaks, advantageous for cracking larger seeds.

17. **B:** Moderate temperature rise increases kinetic energy and collision frequency without denaturing the enzyme.
18. **C** – The dependent variable is the measured outcome that indicates the rate of respiration; here it is the length (or volume) of CO₂ gas produced in a fixed time. Sugar type is the independent variable, while temperature and inoculum volume are controlled variables.
19. **D:** Zero net mass change indicates water potential equilibrium; tissue $\psi \approx$ external ψ (–950 kPa).
20. **A** – A sustained increase in the *number* of species judged to be threatened indicates that extinction risk is spreading to more taxa, consistent with a worsening biodiversity crisis.
21. **B:** Germ cells in seminiferous tubules undergo meiosis and differentiation into spermatozoa.
22. **D:** Ex situ involves removal from natural habitat—captive breeding in controlled facilities.
23. **C:** Hexagonal lattice increases spacing, reducing density, so solid water is buoyant.
24. **D** – All three pigments show minimal absorption around 550 nm, corresponding to green-yellow light, so this wavelength provides the least energy absorbed for photosynthesis.
25. **A** – The inverse correlation between rising wolf density and falling deer density, followed by deer recovery as wolf numbers drop, typifies predator-driven, density-dependent control of a prey population.
26. **C:** $N \approx (80 \times 100)/20 = 400$; unbiased estimate requires equal recapture probability for all individuals.
27. **C:** $1.0 \times 10^{13} \text{ Tg} \times 1.3 \times 10^{-10}$
 $= 1.0 \times 10^{13} \text{ Tg} \times 1.3 \times 10^{-12}$
 $= 1.3 \times 10^1 \text{ Tg} \approx 13 \text{ Tg}$
28. **B** – Arrow B is the vertical distance between the reactants and the peak of the catalysed pathway, which defines the activation energy when an enzyme is present.
29. **A:** Sequential acquisition of jaws, lungs, amniotic egg, then hair minimises evolutionary steps, matching option A.
30. **B:** GAA → GTA alters the coded amino acid from glutamic acid to valine, changing the polypeptide's primary structure—a missense substitution.