

Exercise walk-through

1.8

Gas exchange surfaces and membrane structure (statements 2.1–2.2, core practical 3)

Pearson Edexcel · International A-Level · Biology

Three vessels, three jobs

Vessel	Wall	Job
Artery	thick muscle + elastin, narrow lumen	carry the pulse at high pressure
Capillary	endothelium one cell thick	exchange: short path, big area
Vein	thin wall, wide lumen, valves	low-pressure return, no backflow

Read a health study like an examiner

Your turn

Gum disease correlates with endothelial damage. List three checks before claiming causation.

- A. Who was sampled, how selected, how many?
- B. Were confounders like smoking, age, diet controlled?
- C. Is there a mechanism and a dose-response pattern?

Four routes across a membrane

Route	Gradient	Protein	ATP
Diffusion	down	none	no
Facilitated	down	channel or carrier	no
Active transport	against	carrier pump	yes
Osmosis	water, down water potential	partially permeable membrane	no

Exercises 2.1·2.3

2.1 State three properties of an efficient gas-exchange surface and give the alveolus's version of each. [3]

2.2 Explain why the phospholipid bilayer is described as fluid. [2]

2.3 Name the evidence that finally overturned the Davson–Danielli protein-coat model. [2]

Exercises 2.1·2.3

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2.1 Large surface area – 300 million alveoli per lung; thin barrier – alveolar and capillary walls are each one cell thick; maintained gradient – blood flow and ventilation constantly renew both sides.

2.2 Explain why the phospholipid bilayer is described as fluid. [2]

2.2 The phospholipids are not bonded to one another, so individual molecules can move laterally within their layer, changing the membrane's shape and allowing proteins to drift within it.

2.3 Name the evidence that finally overturned the Davson–Danielli protein-coat model. [2]

2.3 Freeze–fracture electron microscopy split membranes through the bilayer showing protein bumps inside it; the known proteins varied in size and shape, incompatible with continuous uniform coats.

Exercise 3.1

3.1 The table shows the absorbance of betalain leaked from identical beetroot discs after 10 minutes at five temperatures.

Temperature / °C	Absorbance / a.u.
20	0.04
40	0.09
60	0.31
80	0.62
100	0.88

Describe the trend, explain the rise in molecular terms, and predict with a reason what would happen to the results if the discs were not rinsed before testing. [6]

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3.1 Absorbance rises with temperature, slowly at first then steeply. At higher temperature phospholipids gain kinetic energy and the bilayer becomes more fluid, while membrane proteins begin to denature; both increase permeability so betalain leaks out faster. Unrinsed discs would carry surface pigment cut from the cells, giving high readings at every temperature and masking the temperature difference.

Exercises 3.2·3.3

3.2 Frog tadpoles exchange gases across their skin; adult frogs add lungs. Explain why the adult needs the extra surface with reference to surface-area-to-volume ratio, and name one property of skin that still makes it useful for exchange in both stages. [5]

3.3 Explain why the membrane's intrinsic transport proteins cannot diffuse out of the bilayer, referring to their hydrophobic and hydrophilic regions. [4]

Exercises 3.2·3.3

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3.2 As the tadpole grows into an adult, its volume grows faster than its surface area, so per-unit-body demand exceeds what skin alone can supply; lungs add a large internal exchange surface with a rich capillary network. Skin in both stages is thin and well supplied with capillaries, keeping the diffusion distance short.

3.3 Explain why the membrane's intrinsic transport proteins cannot diffuse out of the bilayer, referring to their hydrophobic and hydrophilic regions. [4]

3.3 Intrinsic proteins have hydrophobic regions sitting among the hydrophobic tails and hydrophilic regions lining the pore or facing the solutions either side; moving out of the bilayer would expose hydrophobic regions to water, which is energetically unfavourable, so the protein stays embedded.