

WJEC (Wales) Biology A-level
Topic 2.2: Adaptations for Gas
Exchange
Questions by Topic

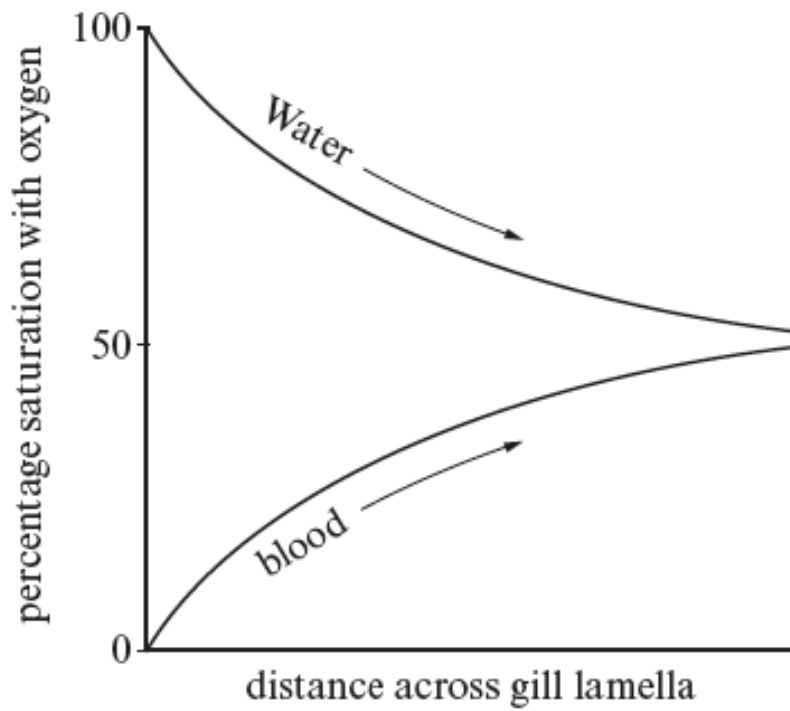
1. (a) Describe and explain the process of **inspiration** in a mammal.

[4]

(b) (i) Explain how counter current flow works in the gills of bony fish.

[4]

The graph below shows another type of flow.



(ii) Name the type of flow shown in the graph above.

[1]

(iii) Explain why this is less efficient than counter current flow.

[2]

(c) Suggest why gill filaments/ lamellae would not provide an efficient gas exchange surface on land.

[2]

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2. (a) Bony fish rely on gills and gill filaments for gaseous exchange. Explain how the presence of gill filaments is an adaptation to gaseous exchange.

[2]

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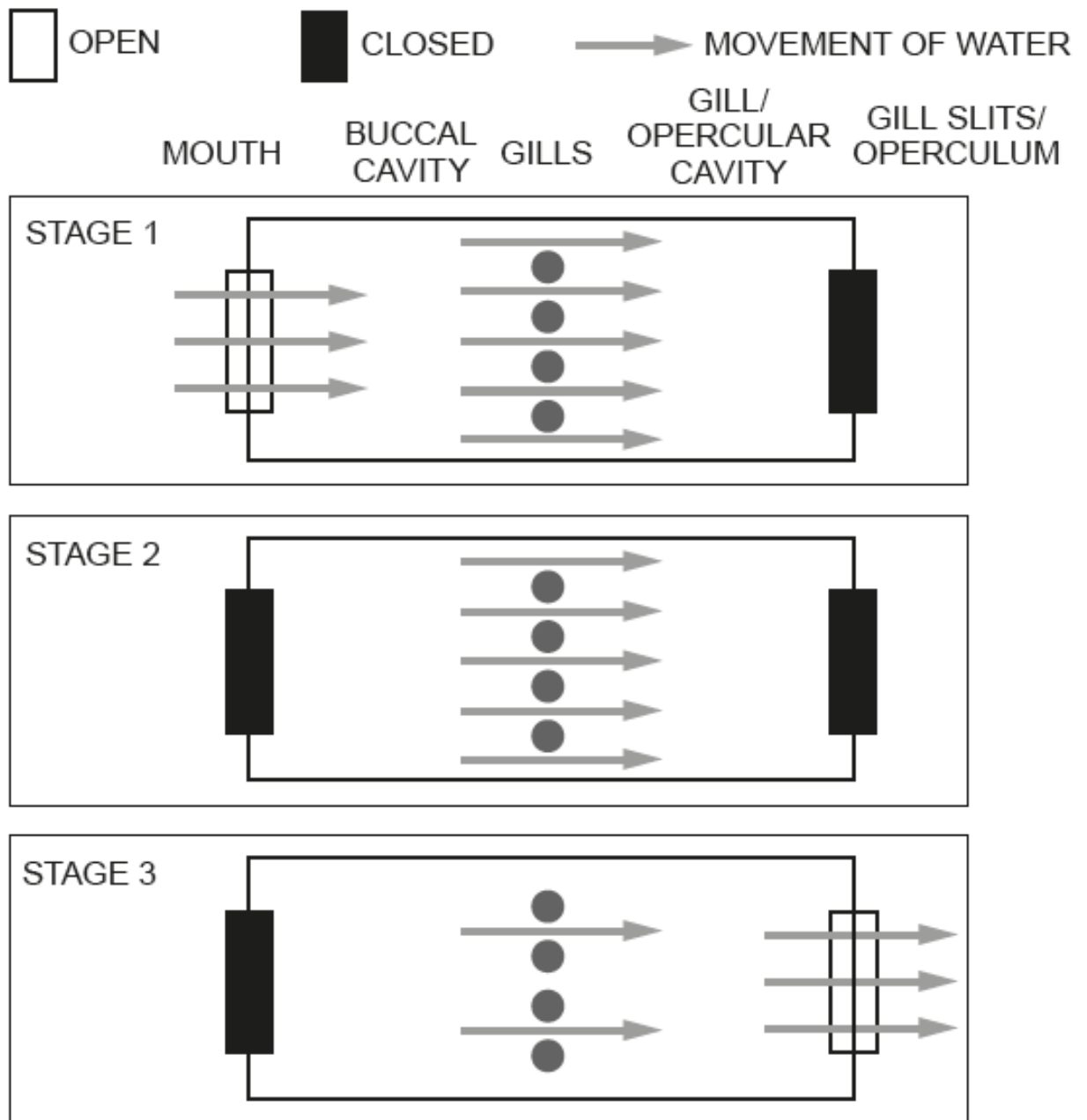
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- (b) The system of ventilation in a bony fish enables water to be passed continuously over its gills whilst the fish is at rest.

The diagrams below show three stages in the process of ventilation.



(i) Ventilation of the gills is achieved by pressure changes in the buccal and gill/ opercular cavities. Using information from the diagram opposite and your own knowledge describe the process of ventilation in a bony fish.

[4]

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(ii) In order to further increase the efficiency of gas exchange, bony fish use a counter current flow. State what is meant by counter current flow and explain how this increases the efficiency of gas exchange in the bony fish.

[3]

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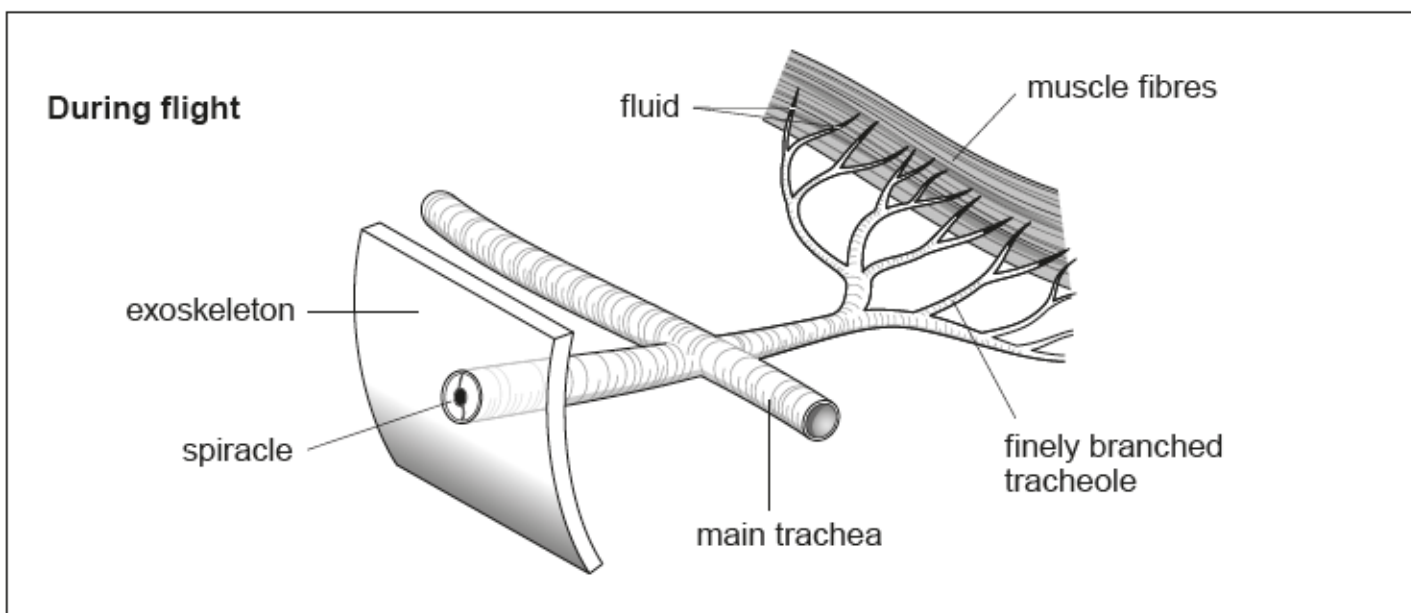
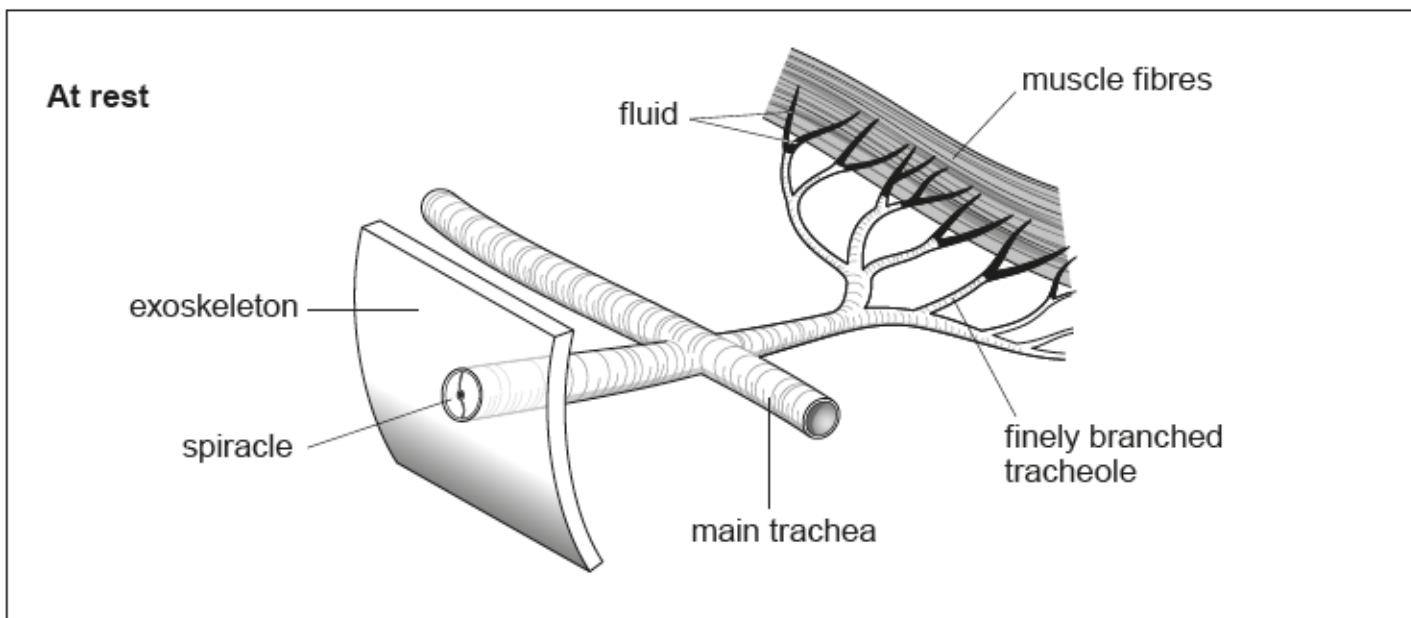
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(c) The diagrams below show insect tracheoles supplying muscle fibres at rest and during flight.



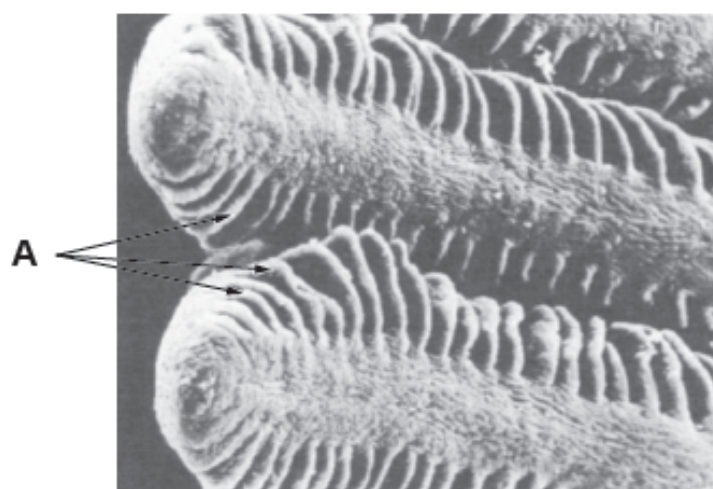
(i) The tracheoles are found on the outside of the muscle fibres. Suggest why the maximum diameter of a muscle fibre never exceeds $20\ \mu\text{m}$ in diameter.

[2]

(ii) Describe the change in fluid level in the tracheoles during flight. Suggest how this change benefits gaseous exchange during flight.

[2]

3. The photograph below shows a scanning electron micrograph of fish gills.



<http://ars.els-cdn.com/content/image>

- (a) Name the structures labelled A in the photograph above.

[1]

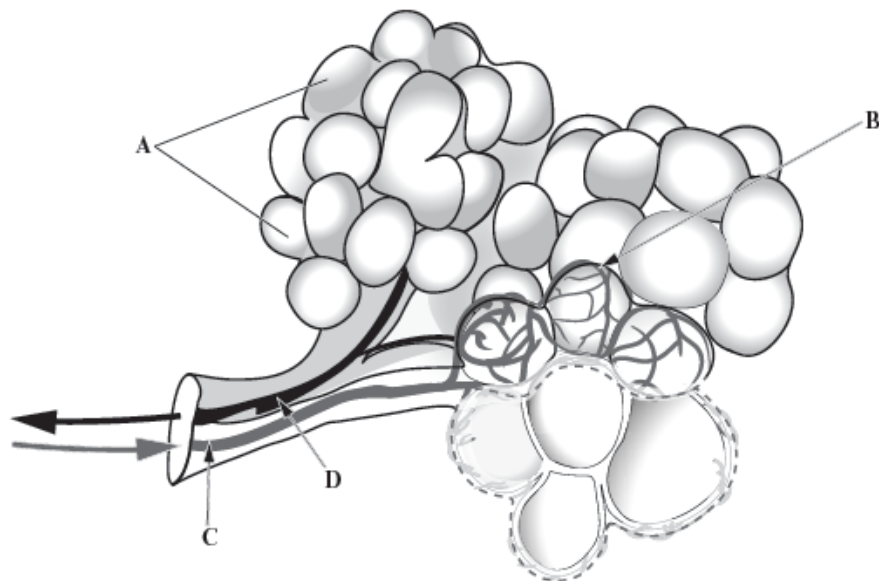
- (b) Describe how a bony fish ventilates its gills and absorbs oxygen from water.

[4]

(c) Using the photograph above and your own knowledge, describe four similarities in the adaptations of the gill for gaseous exchange and a mammalian villus for the absorption of digested products.

[4]

4. The image below shows part of the lung viewed under high magnification. The arrows indicate direction of blood flow.



(a) (i) Identify the structures A and B.

[1]

A

B

(ii) Identify the blood vessels which connect C and D to the heart.

[1]

C

D

(b) State two important structural features of A visible in the diagram.

[2]

1

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2

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(c) Briefly explain how inspiration is brought about.

[2]

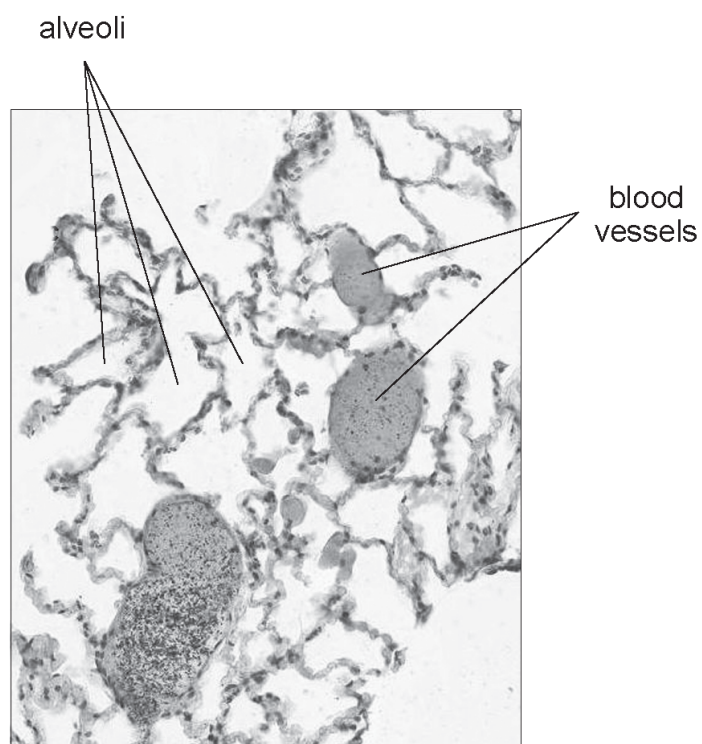
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5.

Shown below is a micrograph of a section through part of a mammalian lung.



- (a) Describe and explain how **two** features **shown in the micrograph** are adaptations for efficient gas exchange. [4]

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(b) (i) Describe and explain the process of expiration in a mammal.

[4]

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(ii) Mammals have a high oxygen demand. Suggest why they need a complex ventilation mechanism. [2]

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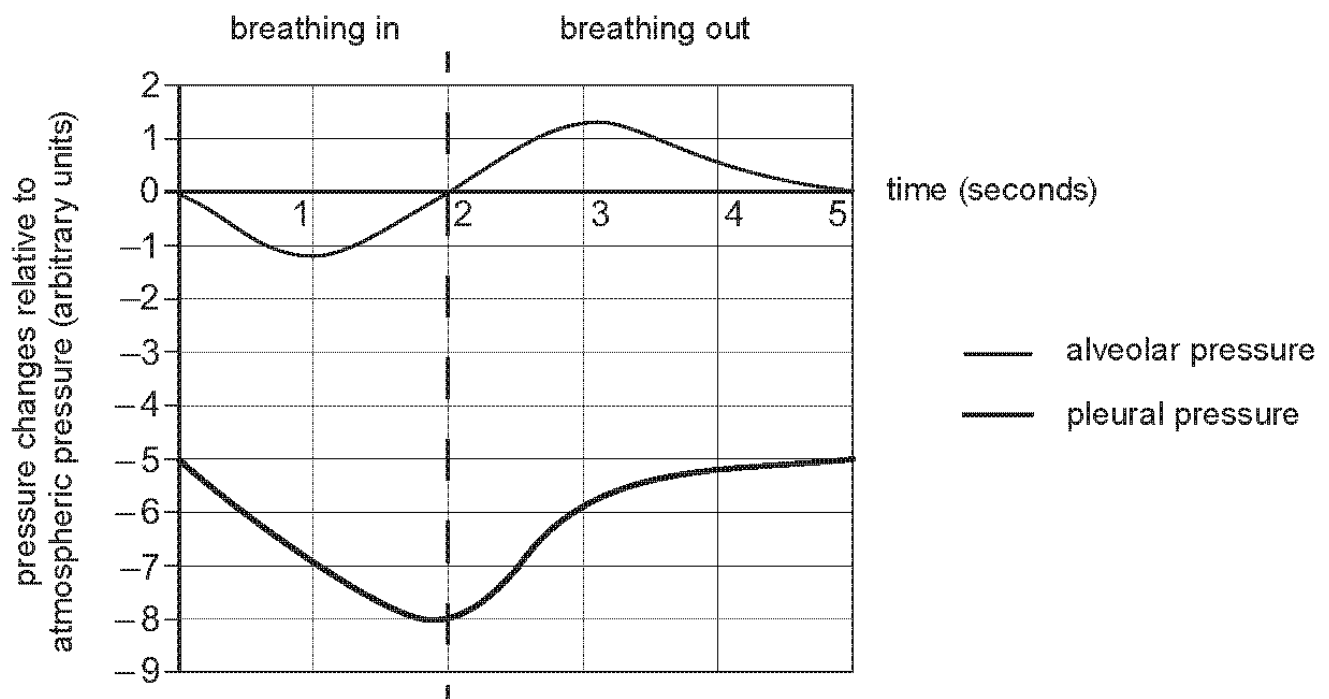
6.

(a) Give two advantages of humans having internal gas exchange surfaces.

[1]

Lungs are enclosed inside the body and so humans have to breathe in actively to get oxygen to the gas exchange surface. Breathing out at rest relies mainly on elastic recoil.

The graph below shows how the pressures in the alveoli and the pleural cavity change during breathing in and out.



- (b) The outer pleural membrane is attached to the ribcage and the inner pleural membrane is attached to the outer surface of the lungs. Using your knowledge of ventilation, and with reference to the graph, explain how the outward movement of the ribcage causes the changes in the pleural and alveolar pressures during breathing in. [4]

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- (c) State one medical use of artificial surfactant and explain why it would be needed. [2]

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7. The photograph below shows a scanning electron micrograph of fish gills.

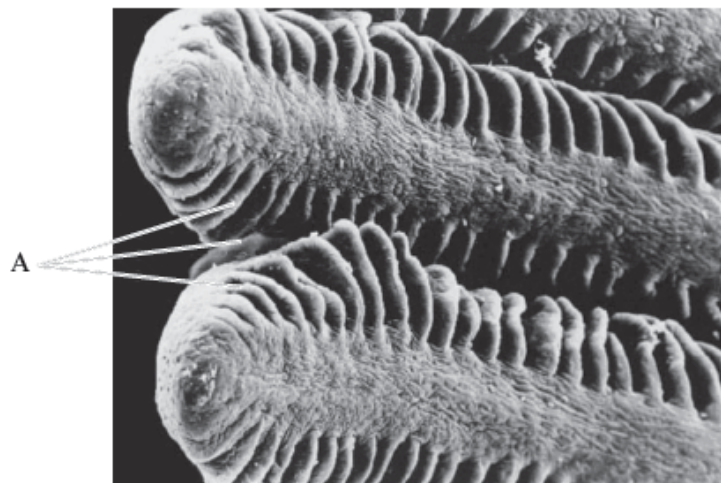


Photo courtesy of Electron Microscopy Unit, Royal Holloway University of London

- (a) Identify structures A.

[1]

(b) Using the photograph above and your own knowledge, describe three features of fish gills which allow them to achieve efficient gas exchange.

[3]

1

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2

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3

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(c) Water is a dense medium with a low oxygen content. Explain how bony fish have overcome the problems of oxygen uptake in water.

[4]

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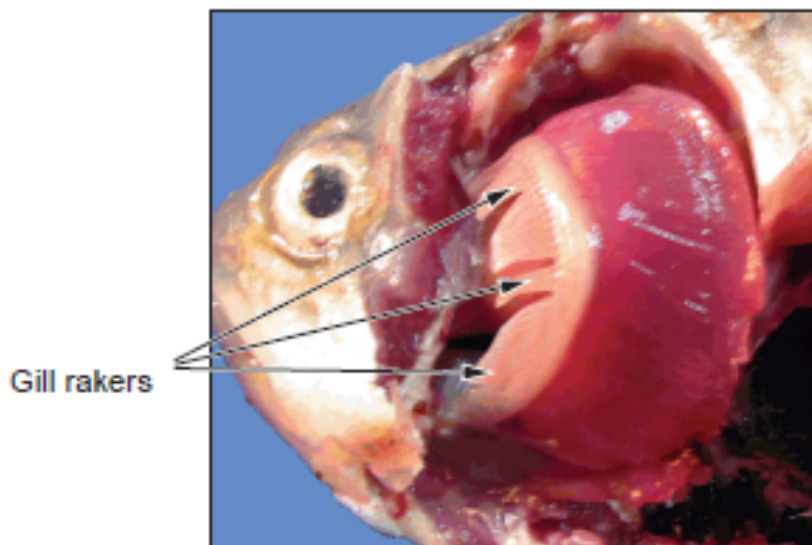
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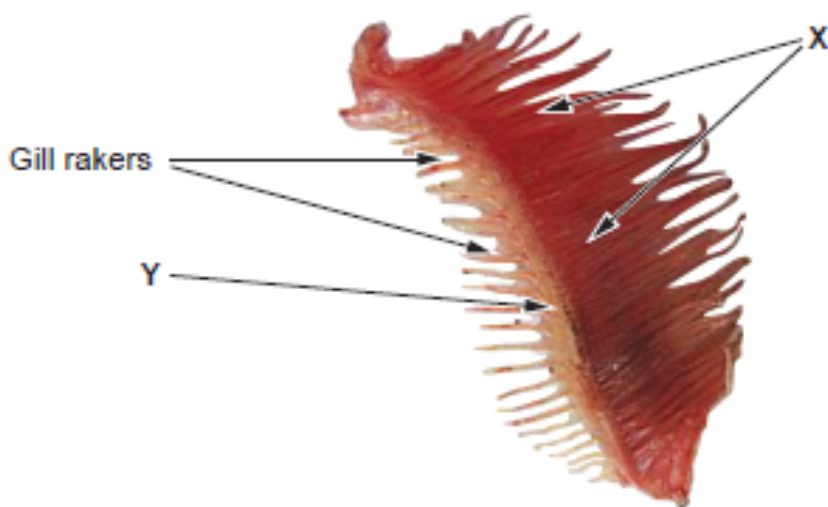
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8. Photograph A shows a freshly dissected bony fish with the operculum removed to show the gills.
Photograph B shows a single gill 30 minutes after having been removed from the fish.

Photograph A



Photograph B



- (a) (i) Identify the structures labelled X and Y in Photograph B. [1]
- X
- Y
- (ii) Suggest the function of the gill rakers. [1]
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- (iii) Use the photographs, and your knowledge, to explain why fish suffocate when out of water. [4]

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- (b) Gas exchange in bony fish uses the countercurrent flow mechanism, where blood flows through the capillaries of the gill lamellae in the opposite direction to water flowing across them. In parallel flow, blood flows through the capillaries of the gill lamellae in the same direction as water flowing across them. Explain the advantages of the countercurrent flow mechanism compared to the parallel flow mechanism. [4]

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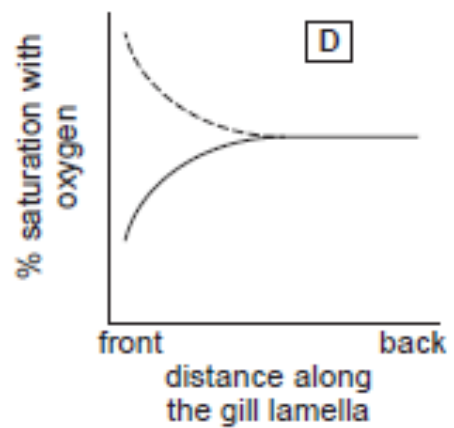
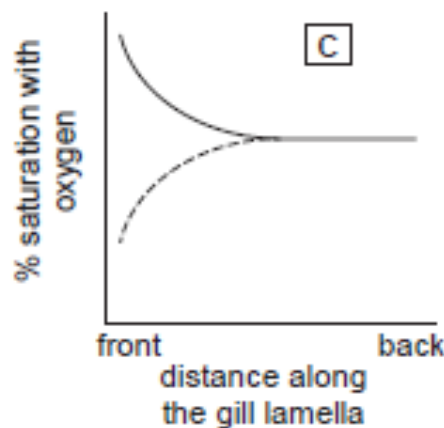
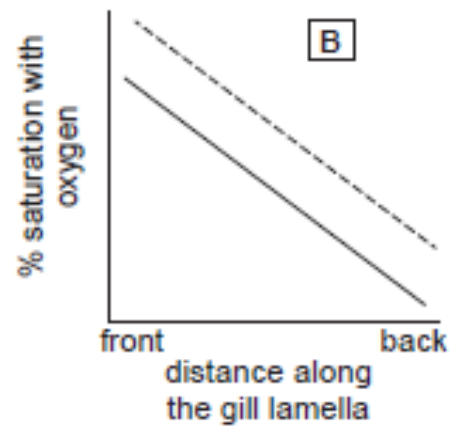
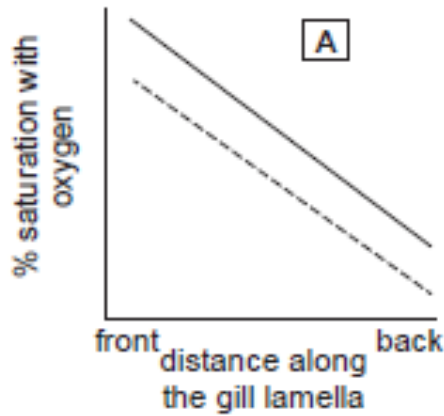
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- (c) The graphs below show representations of changes in oxygen concentration as water flows across the gill lamellae.



Key: ————— = water, - - - - - = blood

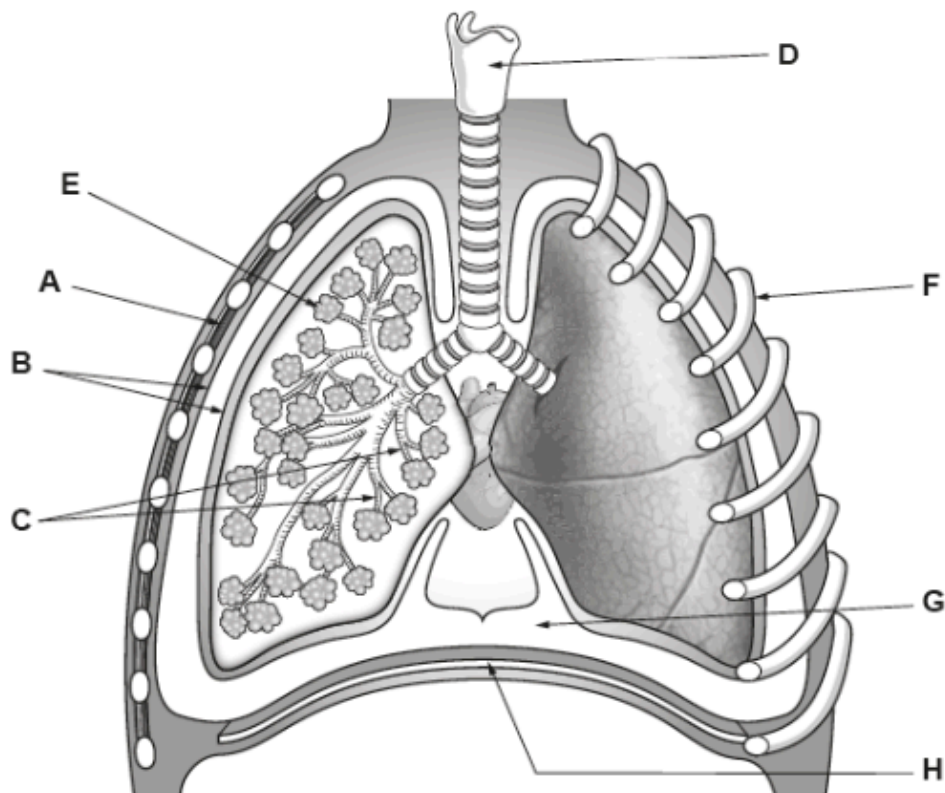
- (i) Identify which graph illustrates parallel flow and which graph illustrates countercurrent flow. [1]

Parallel flow

Countercurrent flow

- (ii) Clearly insert arrows on the graph which represents countercurrent flow to show the direction of blood flow and of water flow. [1]

9. The diagram represents the human respiratory system.



(a) Use some of the letters from the diagram to match the structures to the following functions.

[3]

| Function | Structure |
|---|-----------|
| Flattens during inhalation to increase the volume of the thorax | |
| Become constricted and inflamed during an asthma attack | |
| Contain a surfactant to reduce surface tension | |

(b) The structures labelled **E** have thin walls and are surrounded by an extensive capillary network.

Explain how these adaptations increase the efficiency of gas exchange

[3]

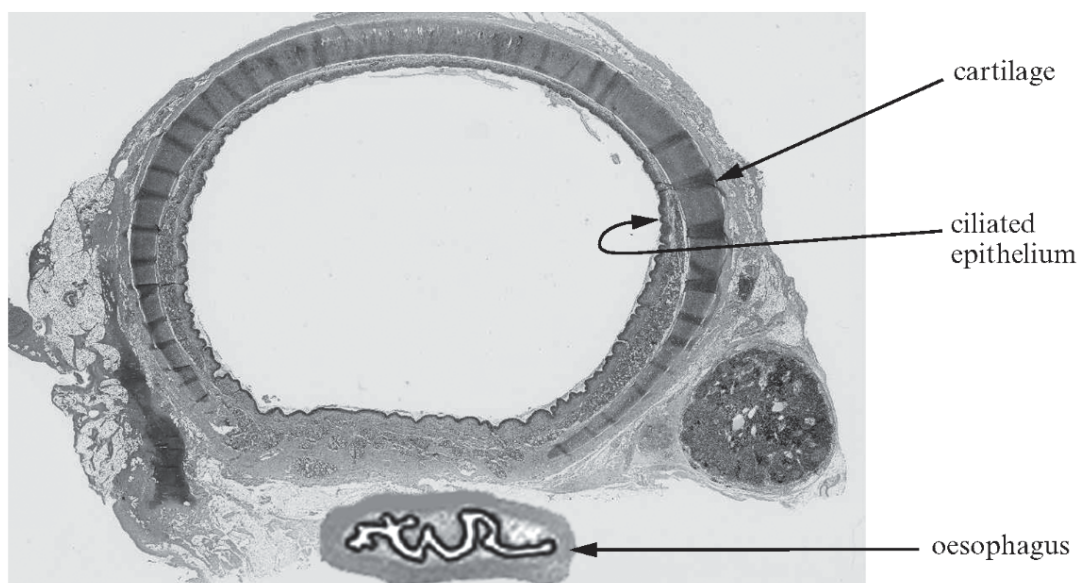
Thin walls
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Extensive capillary network

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10. The micrograph shows a section of the trachea of a human.



- (a) What is the function of the ciliated epithelial layer? [2]

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- (b) (i) What is the function of the layer of cartilage? [2]

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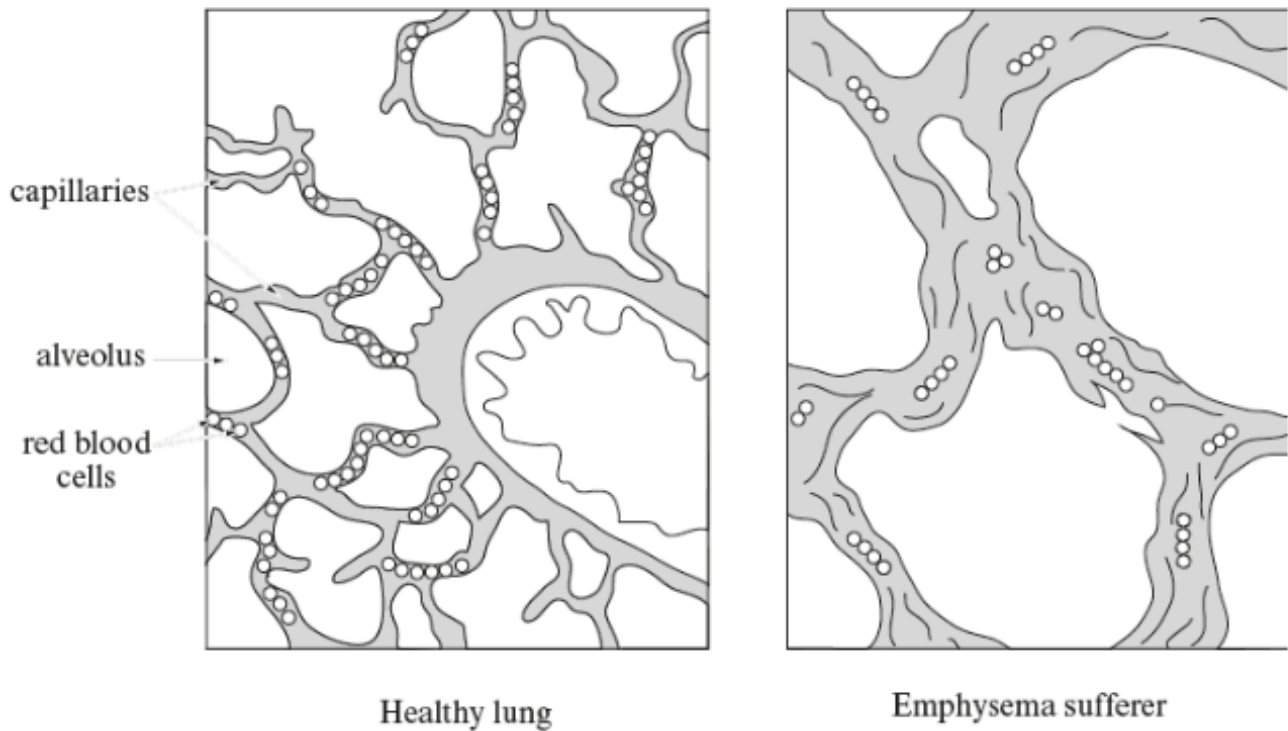
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- (ii) Suggest why the cartilage is not in the form of a complete ring. [1]

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- 11.** The diagrams below show a section through a healthy lung and a section through a lung from a patient suffering from emphysema. Both diagrams are drawn to the same scale.



- (a) List **three** adaptations for gas exchange **shown** in the healthy lung diagram above.

[3]

- (i)
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- (ii)
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- (iii)
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- (b) Describe how **one** of the adaptations listed in part (a) aids gas exchange.

[1]

Adaptation
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Description
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