

The heart, blood vessels and haemoglobin

Why can large animals not rely on diffusion alone?

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What is mass transport?

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What is a double circulation?

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Why do arteries have elastic fibres?

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Why do veins have valves?

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How are capillaries adapted for exchange?

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Name the four valves of the heart.

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Why is the left ventricle wall the thickest?

Movement of fluid (blood) in bulk through vessels over long distances by pressure from a pump.

Small surface area to volume ratio, long diffusion distances and a high metabolic rate.

To stretch and recoil, evening out the pressure surge from the heart so blood flow is smooth.

Blood passes through the heart twice per circuit: right side to the lungs, left side to the body.

Wall one cell thick (short diffusion distance), narrow lumen, large total cross-sectional area (slow flow).

To prevent backflow of blood, since blood pressure in veins is low.

It pumps blood to the whole body at high pressure.

Tricuspid and bicuspid (atrioventricular), and the aortic and pulmonary (semilunar) valves.

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What do the tendinous cords do?

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Give the three stages of the cardiac cycle.

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When do the semilunar valves open?

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How do you calculate the length of the cardiac cycle?

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Describe the structure of haemoglobin.

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In what main form is CO₂ carried in the blood?

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How does haemoglobin act as a buffer?

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What is the Bohr effect?

Atrial systole, ventricular systole, cardiac diastole.

They hold the atrioventricular valves in position so they are not forced back into the atria.

$60 \div \text{heart rate (beats per minute)}$ gives the time in seconds.

When ventricular pressure exceeds pressure in the aorta or pulmonary artery, during ventricular systole.

As hydrogencarbonate ions (HCO_3^-) in the plasma, formed using carbonic anhydrase.

A protein of four polypeptide chains, each with a haem group containing Fe^{2+} that binds one O_2 .

Higher CO_2 (lower pH) shifts the curve to the right: lower affinity, so more oxygen is unloaded.

It binds H^+ ions released when carbonic acid dissociates, preventing a large fall in pH.

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**Why is the oxygen dissociation curve
S-shaped?**

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**How does fetal haemoglobin differ in
affinity from adult?**

Higher affinity for oxygen: curve to the left, so it loads oxygen at the low pO_2 of the placenta.

Cooperative binding: once one O_2 binds, the shape changes so the next binds more easily; flattens when nearly full.