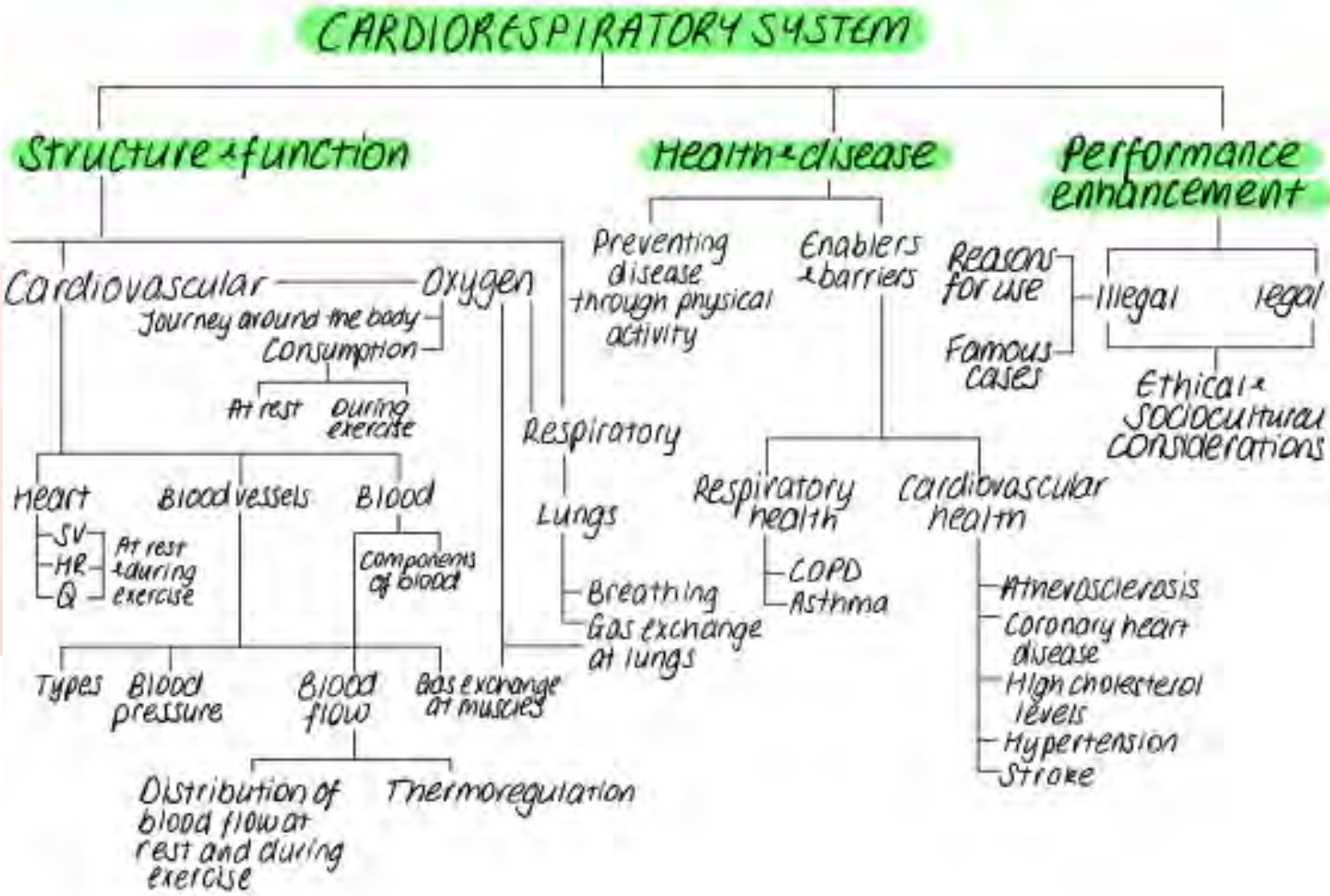
VCE PHYSICAL EDUCATION

BLOOD VESSELS

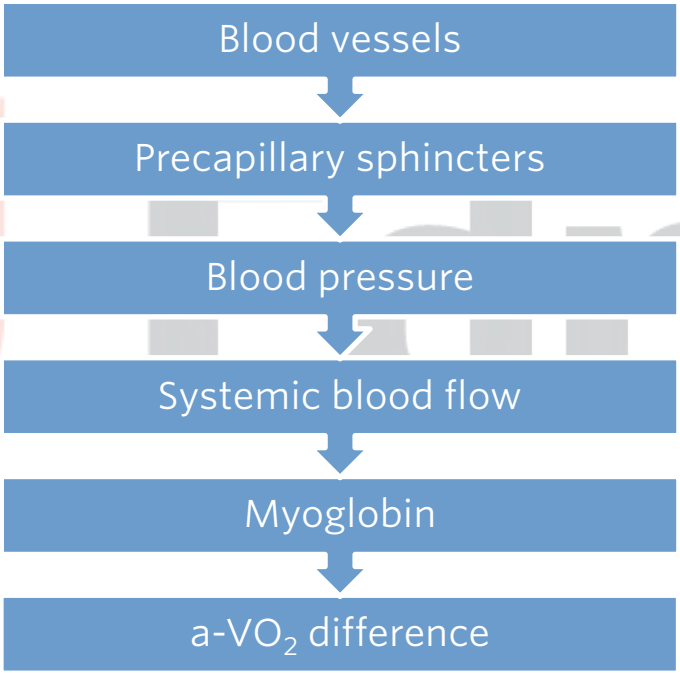
Presented by Chris Hudd

Study Design Dot Points:

• the structure and function of the cardiovascular system, including the structure and function of the heart and blood vessels, and blood flow around the body both at rest and during exercise


CARDIORESPIRATORY SYSTEM
Structure & function
Health & disease
Performance enhancement
Cardiovascular
Oxygen
Journey around the body
Consumption
At rest
During exercise
Respiratory
Heart
Blood vessels
Blood
SV
HR
Q
At rest & during exercise
Components of blood
Lungs
Breathing
Gas exchange at lungs
Types
Blood pressure
Blood flow
Gas exchange at muscles
Distribution of blood flow at rest and during exercise
Thermoregulation
Preventing disease through physical activity
Enablers & barriers
Respiratory health
COPD
Asthma
Cardiovascular health
Atherosclerosis
Coronary heart disease
High cholesterol levels
Hypertension
Stroke
Reasons for use
Famous cases
Illegal
Legal
Ethical & sociocultural considerations

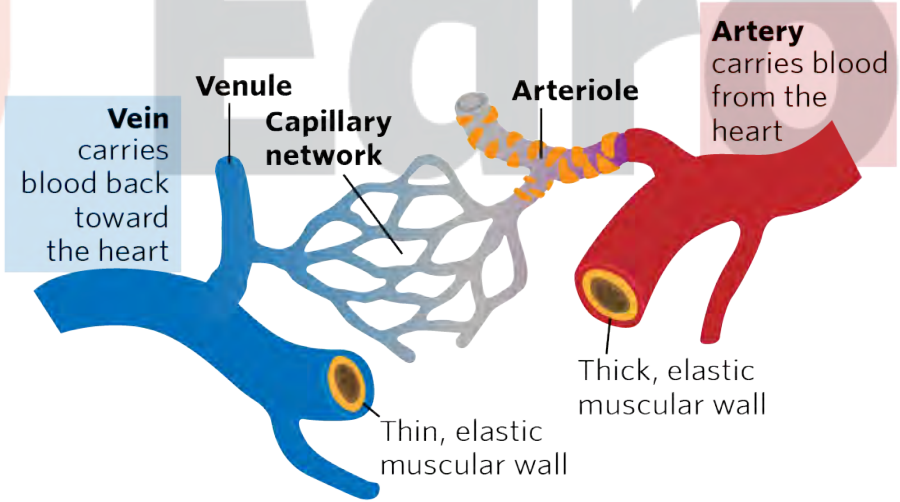
This lesson



- Blood vessels
- Precapillary sphincters
- Blood pressure
- Systemic blood flow
- Myoglobin
- a-VO_2 difference

Blood vessels

Blood vessels form a large network, which allows blood to flow to all parts of the body.
The vascular network consists of arteries – for carrying blood away from the heart – that then branch into arterioles, and further branch into capillaries.
The capillaries then connect to venules, that then become veins; these allow the blood to return to the heart.




Source: https://c1.staticflickr.com/9/8344/8215222181_74c8a427f7.jpg

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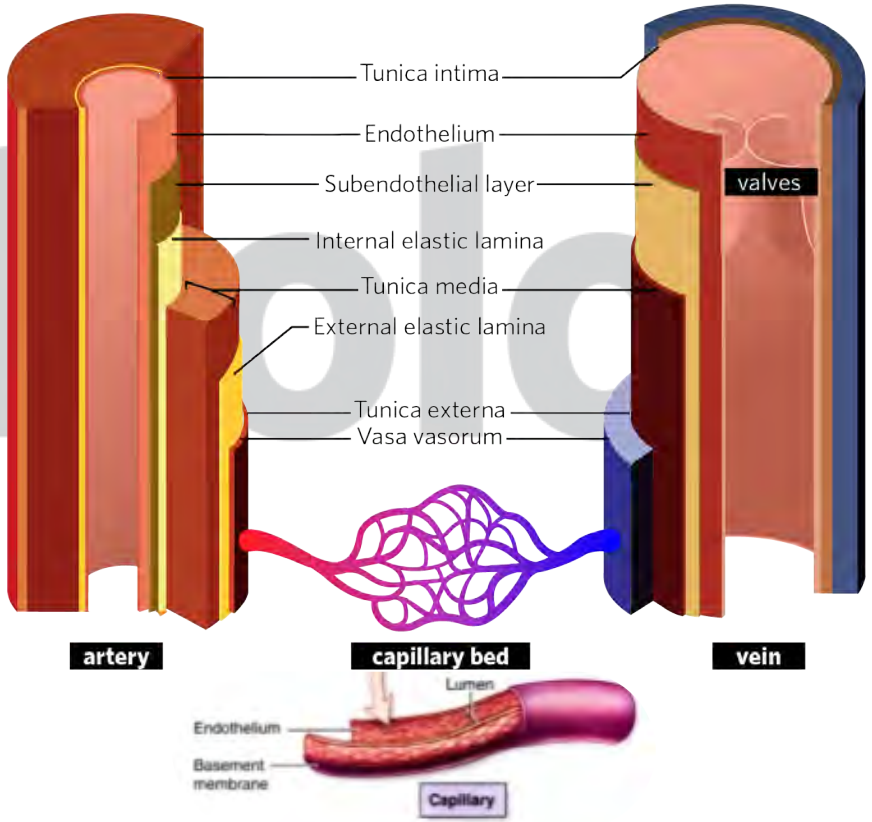
Blood vessels

Arteries are large blood vessels with thick walls that carry large volumes of blood away from the heart.

Capillaries are tiny blood vessels that create a network between the arterioles and venules. They are the sites for gas exchange between the bloodstream and the muscles.

Veins are much less elastic, and contain pocket valves that prevent backflow of venous return.



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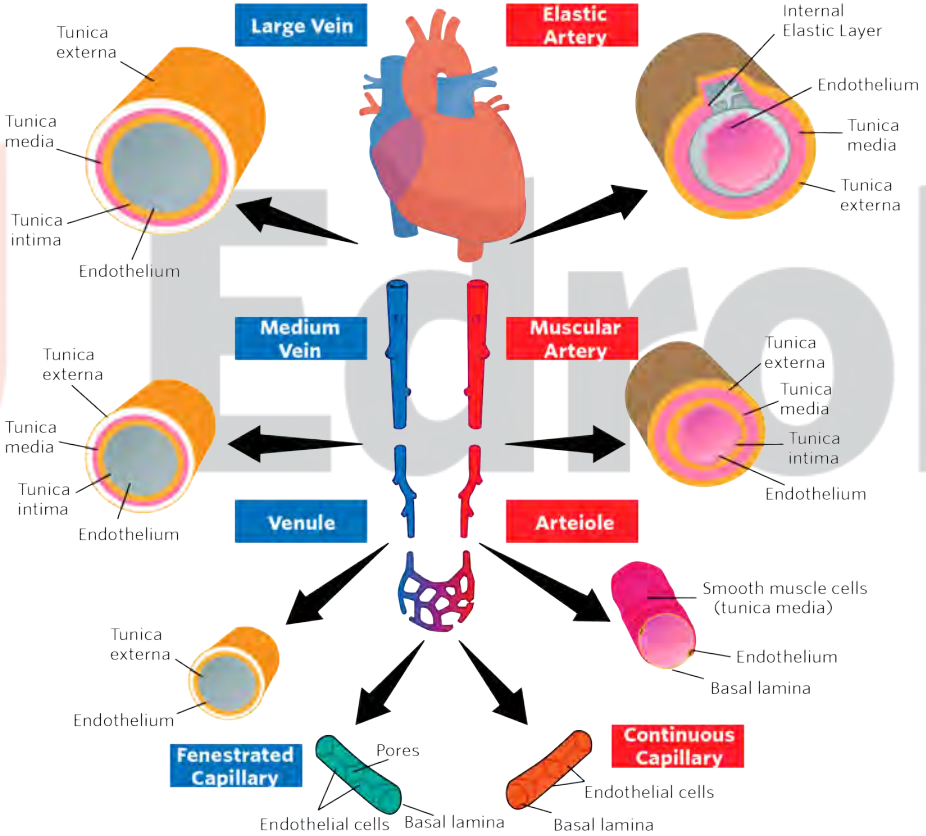
Blood vessels



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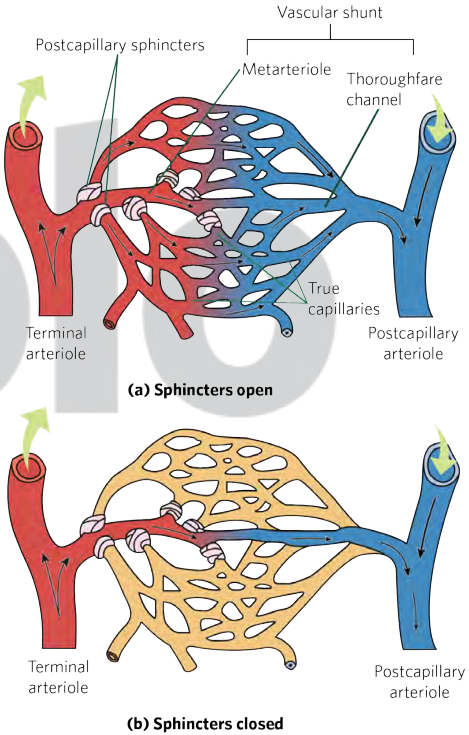
Precapillary sphincters

Precapillary sphincters are bands of smooth muscle that surround each branch of the capillary at its exit from the arteriole.

These muscles control the blood flow through the capillaries by opening and closing branches.

This plays a major role in the distribution of blood around the body.



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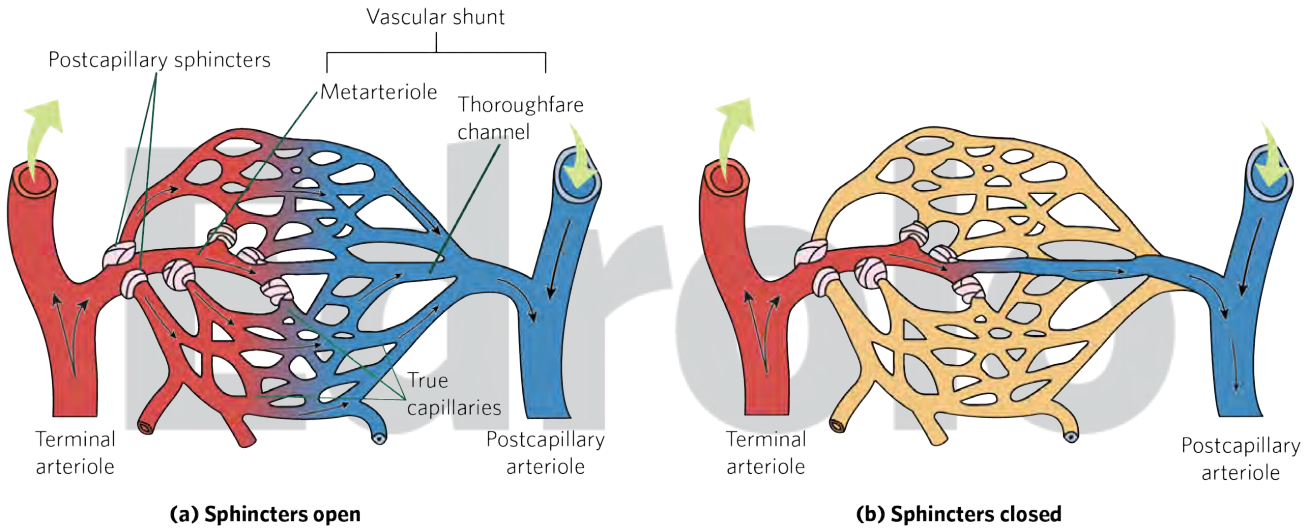
Precapillary sphincters



(a) Sphincters open **(b) Sphincters closed**

Short answer activity – Write a response

Discuss why Tour de France cyclists, like Chris Froome pictured below, would benefit from having a high density of capillaries surrounding their skeletal muscles.

(3 marks)

[Written by the author]

Short answer activity – Mark this response

Discuss why Tour de France cyclists, like Chris Froome (pictured below), would benefit from having a high density of capillaries surrounding their skeletal muscles.

(3 marks)

Sample response:

Having a high capillary density enables more sites for gaseous exchange between the cardiovascular system and the muscles.
This will mean that more oxygen is able to diffuse across from the capillaries to the working muscles; therefore, Froome is able to produce greater amounts of aerobic energy.

Key point	Mark allocation
Discussion of how an increased capillary density provides more sites for gaseous exchange.	1 mark
Discussion of how this would lead to an increased amount of oxygen provided to the working muscles.	1 mark
Discussion of how this would lead to an increased aerobic contribution and therefore more resistance to fatigue.	1 mark

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Short answer activity – Read this top band exemplar

Discuss why Tour de France cyclists, like Chris Froome (pictured below), would benefit from having a high density of capillaries surrounding their skeletal muscles.

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Exemplar response:

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An increased aerobic contribution during the endurance event will mean that the cyclist is less reliant on the anaerobic energy systems that accelerate fatigue.

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[Written by the author]

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Blood pressure

Blood pressure is the pressure exerted by the arterial blood against vessel walls as it is forced through the cardiovascular system.

Systolic blood pressure is the pressure recorded during the contraction phase of the heart cycle.

Diastolic blood pressure is the pressure recorded during the relaxation phase of the heart cycle.

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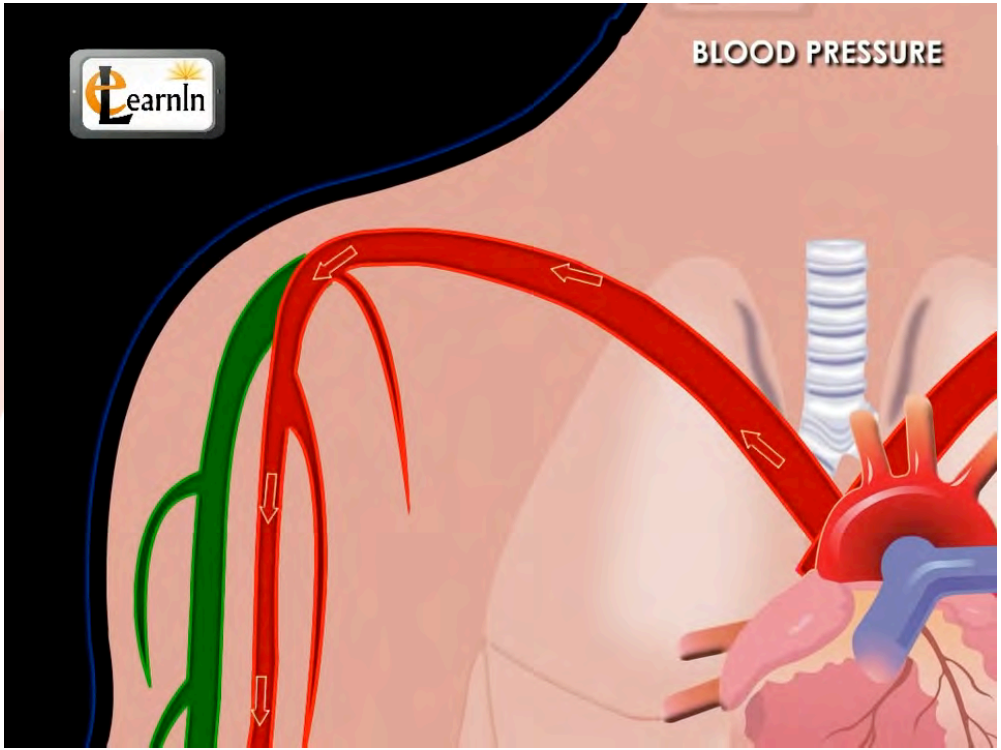
Blood pressure



https://www.youtube.com/watch?v=qWti317qb_w&t=29s

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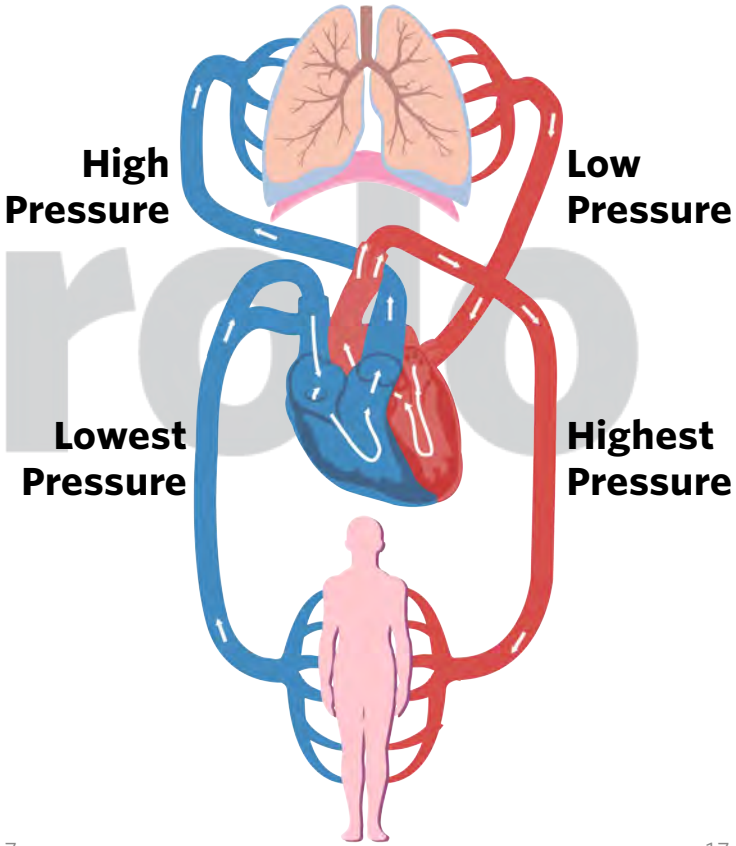
Systemic blood flow

The diagram pictured shows the systemic blood flow, in which the arteries and veins feed blood from the heart, to the whole body, and back to the heart again for reoxygenation.



Multiple choice activity

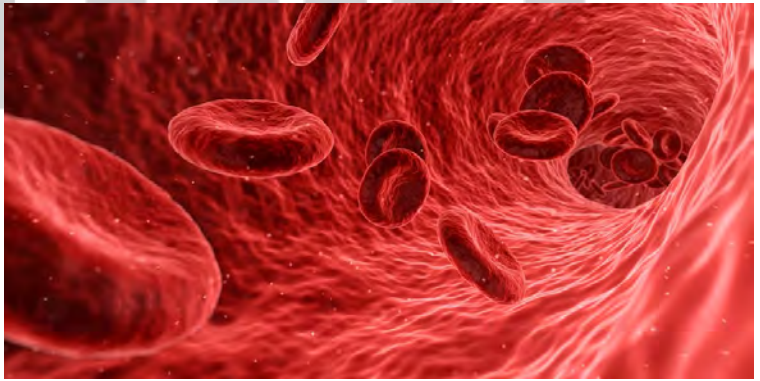
Systemic circulation is when:

A. deoxygenated blood is transported away from the heart and circulated to the lungs, and oxygenated blood returns to the heart via the pulmonary vein.

B. oxygenated rich blood is transported from the heart and into the arteries around the body, and deoxygenated blood returns to the heart via the venous system.

C. oxygenated blood is transported away from the heart and circulated to the lungs, and deoxygenated blood returns to the heart via the pulmonary vein.

D. deoxygenated rich blood is transported from the heart and into the arteries around the body.



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Insight Exam 1 2011 Q14

Multiple choice activity

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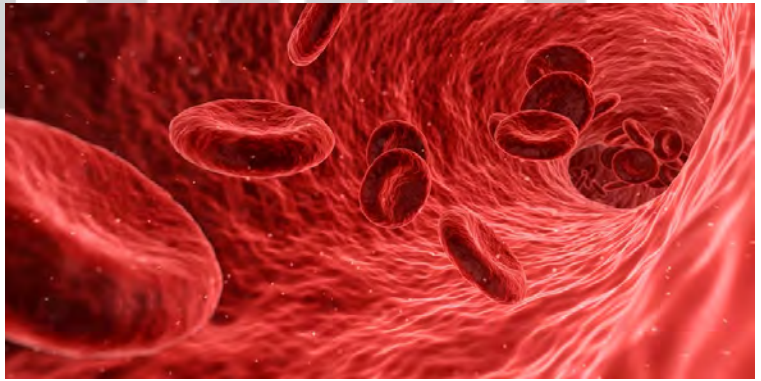

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Insight Exam 1 2011 Q14

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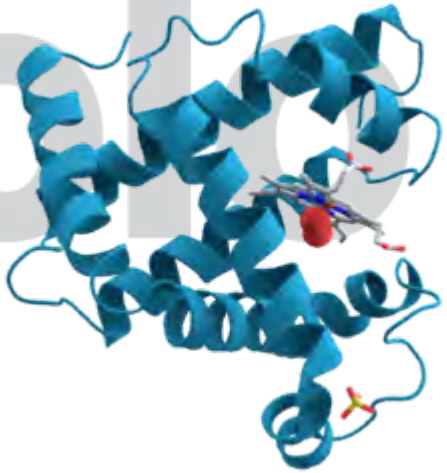
Myoglobin

Myoglobin is a molecule in muscle that plays an important role in oxygen uptake as oxygen moves from the capillaries (bloodstream) and into the muscles where it attaches to myoglobin.



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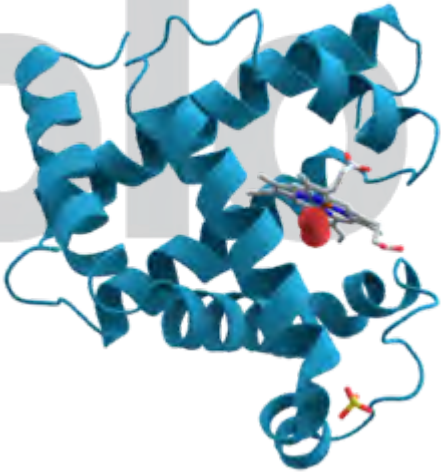
Short answer activity – Write a response

Outline the role of myoglobin in the aerobic production of ATP.

(1 mark)



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VCAA 2015 Exam Section B Q2b

Short answer activity – Read this top band exemplar

Outline the role of myoglobin in the aerobic production of ATP.

(1 mark)

Exemplar response:
Myoglobin is a molecule within the muscle that is responsible for initially attracting the oxygen into the muscle cell (from the capillary), before allowing the oxygen to bind to it for transport within the muscle to the mitochondria.

Marking rubric:

Key points	Mark allocation
Role of myoglobin outlined	1 mark

Short answer – Teacher's analysis

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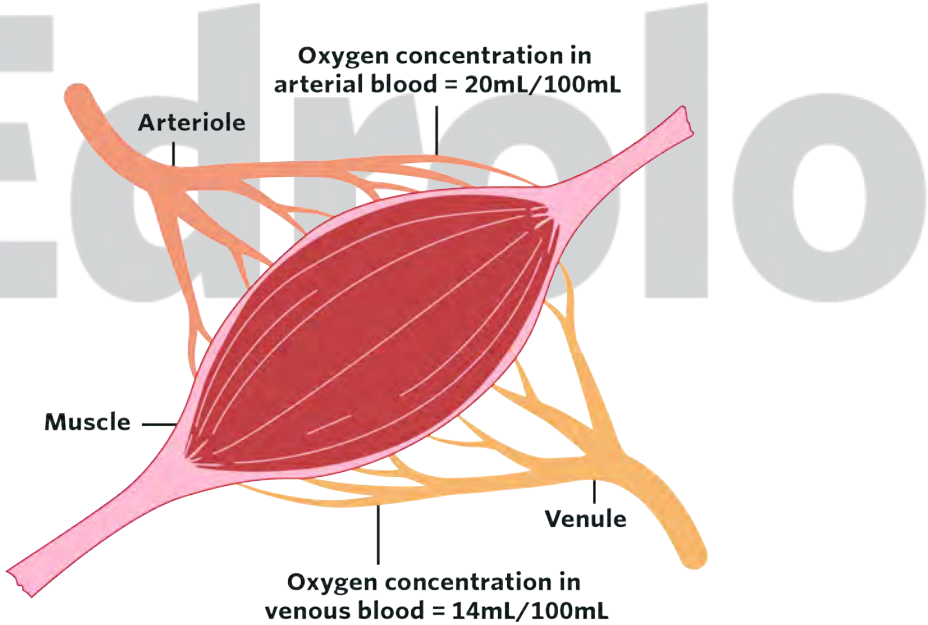
Arteriovenous Oxygen Difference (a-VO_2 diff)

a-VO_2 difference is a comparison of the concentration of oxygen in the arterial blood when compared to the concentration of oxygen in the venous blood.



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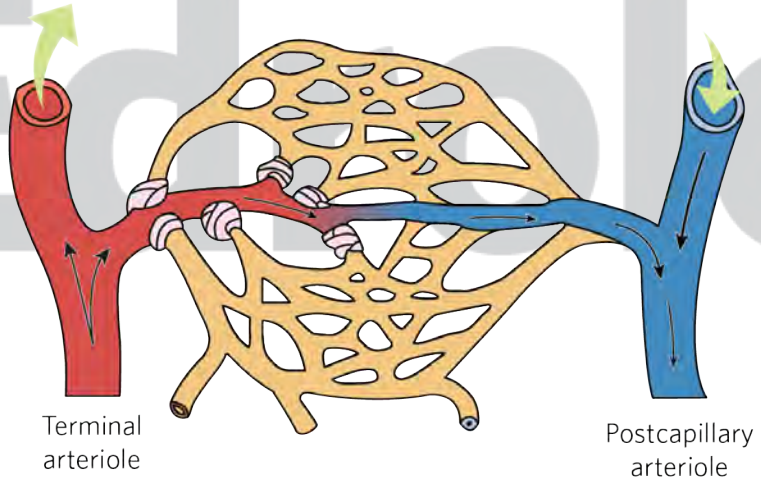

Multiple choice activity

At rest, the arteriovenous oxygen difference (a-VO_2 diff.) is:

A. less than during exercise.

B. the same as during exercise.

C. greater than during exercise because O_2 is redistributed to vital organs.

D. greater than during exercise because O_2 consumption increases to repay excess post-exercise oxygen consumption (EPOC).

VCAA 2011 Exam Section A Q11

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Short answer activity – Write a response

As a result of months of aerobic training, athletes will have a series of cardiovascular adaptations that will lead to improved performance.

Discuss how an increased stroke volume (Cardiac), an increased capillary density at the muscles, and an increased myoglobin content within the muscles will lead to an increase in the arteriovenous oxygen difference (a-VO_2 diff) under maximal exercise conditions.

(4 marks)

Written by the author

Short answer activity – Read this top band exemplar

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Marking rubric:

Key points	Mark allocation
Definition of a-VO_2 difference	1 mark
Increased stroke volume's role in increasing a-VO_2 difference	1 mark
Increased capillary density's role in increasing a-VO_2 difference	1 mark
Increased Myoglobin content's role in increasing a-VO_2 difference	1 mark

Short answer activity – Read this top band exemplar

Exemplar response:

A-VO_2 difference is the difference in the oxygen concentration between the arterial and venous blood.

An increase in the stroke volume will result in a greater amount of oxygenated blood being pumped per beat of the heart, providing the muscles with a greater supply of oxygen for uptake.

An increase in the density of capillaries at the muscle site will result in more sites for gas exchange between the capillary and the muscle itself. This will increase the amount of oxygen uptake.

An increase in myoglobin levels within the muscle will result in a greater uptake of oxygen by the muscle, as more oxygen is attracted into the cell.

All of these changes ultimately result in increased levels of oxygen being, firstly, readily available for uptake, and secondly, actually being up-taken.

Written by the author

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Increased capillary density's role in increasing a-VO_2 difference	1 mark
Increased Myoglobin content's role in increasing a-VO_2 difference	1 mark

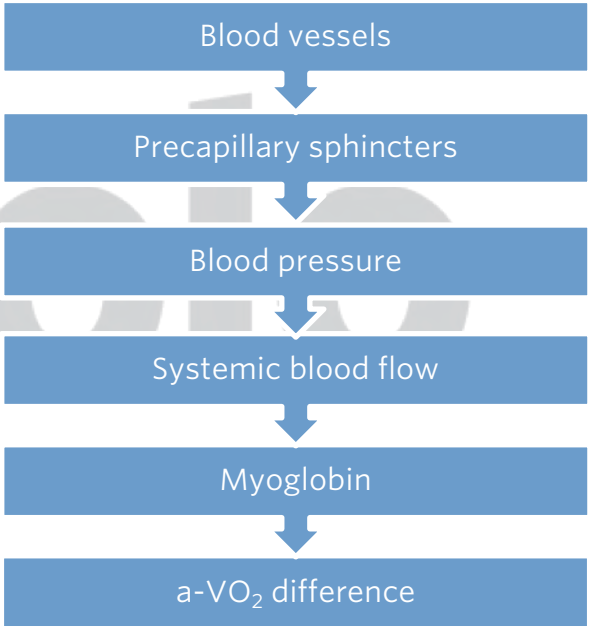
Bringing it all together

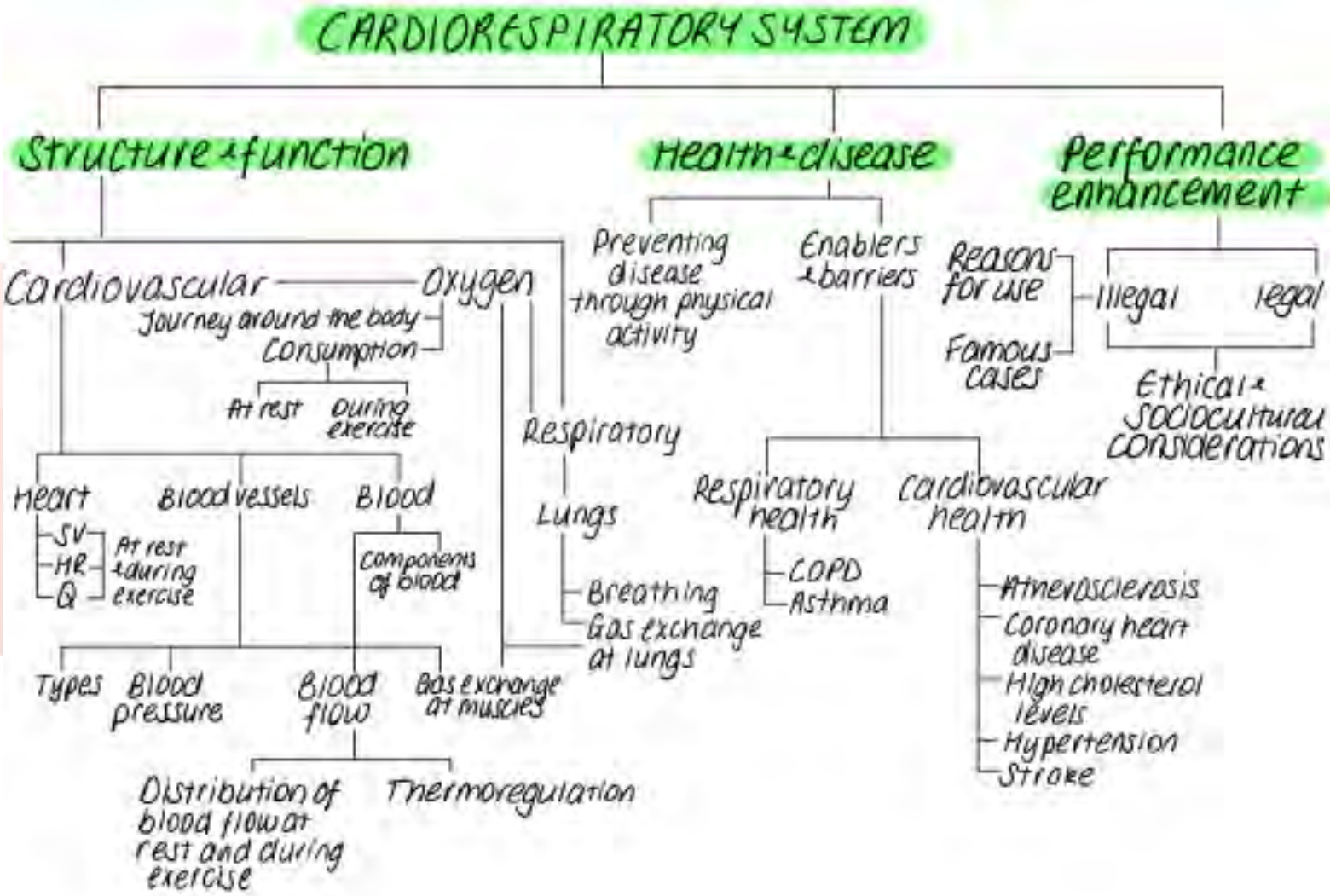
Blood vessels create a closed network around the body.
Arteries, Arterioles, Capillaries, Venules, Veins

Arteries are thick vessels that transport blood with a high pressure.
Capillaries are thin vessels that facilitate gas exchange between the vessel and body tissue (e.g. muscles)
Veins transport blood with low pressure back to the heart and lungs.

Blood pressure is the pressure exerted by the blood against the vessel walls.
Systolic – when heart is contracting
Diastolic – when heart is relaxed

A-VO_2 Difference is the difference in the oxygen content in the arterial blood, when compared to the venous blood.

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Reasons for use
Famous cases
Illegal
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We do our best to make these slides comprehensive and up-to-date, however there may be errors.
We'd appreciate it if you pointed these out to us!