

# AS Module 3 (a)

## *PHYSIOLOGY AND TRANSPORT*

### Introduction

This module concentrates on mass transport systems in mammals and flowering plants. It builds on principles established in Module 1 and explores how substances are transported to and from exchange surfaces. In addition to the study of the human blood system, work on exercise is included to explain how human systems are adapted for differing demands on the body. Candidates should thereby acquire an overview of the range of processes involved and be able to relate their understanding to everyday experience. In studying transport in plants there is emphasis on structural and physiological adaptations of plants for survival in unfavourable environmental conditions. There is also the opportunity to evaluate evidence in a topic where understanding is still incomplete and thus to develop understanding of scientific investigation.

This module includes part of the knowledge and understanding specified in the mandatory subject criteria for Advanced Subsidiary Biology, as set out in the document issued by QCA in June 1999. It covers sections 3.10 and 3.11 of that document.

### 12.1 Transport systems

#### Mass transport

Over large distances in organisms, efficient supply of materials is provided by mass transport (the bulk movement of substances through transport systems).

The transport systems of larger organisms are intimately linked with specialised exchange systems, whose main function is to maintain concentration gradients.

#### Mammalian heart

The structure and function of the heart, including the atria and ventricles, atrioventricular and semilunar valves. The cardiac cycle related to the maintenance of blood flow through the heart.

**Candidates should be able to** relate pressure and volume changes in the heart and aorta to events in the cardiac cycle.

#### Blood vessels

The structure of arteries, arterioles, veins and capillaries related to their functions.

#### Exchange of materials

The main substances transported by the blood system, and the sites at which exchange occurs.

The loading, transport and unloading of oxygen in relation to the oxygen haemoglobin dissociation curve, and the effects of pH and carbon dioxide concentration.

#### Tissue fluid

The relationship between blood, tissue fluid, lymph and plasma.

The role of the lymph system in the return of tissue fluid to the blood system.

## 12.2 The control of breathing and heartbeat

Control of ventilation	<p>The role of the medulla in the brain and of the stretch receptors in the lungs in the maintenance of breathing.</p> <p>The role of the medulla in the brain and of the receptors in the lungs, aortic bodies and carotid bodies in the response of the breathing system to increased muscular activity.</p>
Control of heartbeat	<p>The role of the sinoatrial node, the atrioventricular node and the bundle of His in the maintenance of the heartbeat.</p> <p>The role of the medulla, pressure receptors and chemoreceptors in the walls of the aorta and carotid sinuses in the response of the heart to increased muscular activity.</p>

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## 12.3 Energy and exercise

Energy sources	<p>Glucose, glycogen and triglycerides as sources of energy for muscle contraction.</p> <p>ATP as the immediate energy source.</p> <p>Comparison of aerobic and anaerobic respiration as sources of ATP for muscle contraction, in terms of amounts of energy produced and products. (Biochemical details of pathways are <b>not</b> required.)</p>
Muscle fatigue	<p>Muscle fatigue in terms of increase in blood lactate and decrease in blood pH.</p> <p>The fate of lactate.</p>

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## 12.4 The transport of substances in plants

Root structure	<p>Structure of a primary root, to include root hairs, endodermis, xylem and phloem. The distribution of these tissues and their adaptations for function.</p>
Uptake and the transpiration stream	<p>Uptake of water and ions from the soil.</p> <p>Pathway of transport of water from root hairs to stomata, including apoplast and symplast pathways in the root.</p> <p>Transpiration, and the effects of light, temperature, humidity and air movement.</p> <p>The roles of root pressure and cohesion–tension in moving water through the xylem.</p>
Xerophytes	<p>Structural adaptations that reduce the rate of transpiration in xerophytic plants, related to survival in dry conditions.</p>
Translocation	<p>Phloem as the tissue that transports organic substances.</p> <p>The mass flow hypothesis for the mechanism of translocation in plants.</p>
Experimental evidence	<p>The use of radioactive tracers and ringing experiments to determine the movement of ions and organic substances through plants.</p> <p><b>Candidates should be able to</b> interpret evidence from tracer and ringing experiments and to evaluate the evidence for and against the mass flow hypothesis.</p>

## AS Module 3 (b)

### *COURSEWORK*

Candidates will be assessed on the following four practical skills taken from one or more practical investigations based on the AS Subject Content of Modules 1 to 3(a).

- A. Planning
- B. Implementing
- C. Analysing evidence and drawing conclusions
- D. Evaluating evidence and procedures.

This component will be marked by the teacher and moderated by the Awarding Body.

For further details, see Sections 18-24.