CfE

HIGHER HUMAN BIOLOGY

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BrightRED Study Guide

CfE HIGHER

HUMAN BIOLOGY

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INTRODUCING CFE HIGHER HUMAN BIOLOGY

The CfE Higher Human Biology course is divided into four units:

- Unit 1: Human Cells
- Unit 2: Physiology and Health
- Unit 3: Neurobiology and Communication
- Unit 4: Immunology and Public Health

Units 1 and 2 are full units and Units 3 and 4 are half units.

ASSESSMENTS

To gain the CfE Higher Human Biology course award, you must pass all four units, as well as the Course Assessment.

Unit Assessments

- Each of the four units is assessed within your school using SQA Unit assessments.
- Practical abilities are also assessed internally. You are required to write a report of one of the investigations that you have carried out.

Course Assessment

The Course Assessment is made up of two components with a total of 120 marks. It will be graded A to D, which is determined on the basis of the total mark for both components.

Component 1: Question Paper

You will sit an externally assessed written examination consisting of a paper lasting 2 hours 30 minutes. It will be carried out under exam conditions and marked by SQA. This examination has an allocation of 100 marks and is divided into 2 sections:

1. Section 1 is the Objective Test which is worth 20 marks and consists of 20 multiple-choice questions.
2. Section 2 is worth 80 marks and contains restricted and extended-response questions. The extended-response questions each have a mark allocation of between 6 and 9 marks.

Marks for this written paper are distributed (approximately) proportionately across all four Units and the majority of the marks are allocated for applying knowledge and understanding. The remainder of the marks are awarded for applying scientific enquiry, analytical thinking and problem-solving skills.

Component 2: Course Assignment

The Course Assignment is worth 20 marks. You will investigate a relevant topic in biology that is related to one or more of the key areas in the Higher Human Biology course and then communicate your findings. This requires you to demonstrate your application of scientific-enquiry skills, and related biological knowledge and understanding.

Exam Hints

You do not need to answer the questions in order. At the beginning of the exam, find a question that you can answer easily, so that you settle your nerves.

Timekeeping is important, if you are to complete the whole paper. As a general rule, you should be taking just under one and a half minutes per mark. So, allowing ten minutes for settling at the start and checking your paper at the end, the timing for each section should be roughly:

contd

- Section 1, Objective Test: 25–30 minutes
- Section 2: approximately 1 hour 50 minutes.

Remember to look at the mark allocation for each question. Extended-response questions worth from 6 to 9 marks will require more lengthy answers – remember to allocate sufficient time to these.

Revision Tips

- Don't leave your revision until the last minute. Make up a revision schedule, giving yourself enough time to revise thoroughly, and stick to it. Be realistic – you should work around your other activities and remember that you do need to take time off to relax.
- Find somewhere to study that is quiet and uncluttered. You need space to spread out your work.
- Study for short periods (between 30 and 45 minutes) with short breaks in between, to keep up your level of concentration. Go out of the room where you are studying during each break; you will return refreshed and ready for your next study session.
- Read over each sub-topic at a slower pace than you would usually do, asking yourself questions or reading aloud. Make sure that you understand what you have been reading – you only learn what you understand.
- It's often easier to remember facts if you talk about topics with a family member or a friend. So, find a study buddy who can ask you questions about your work.
- Practice makes perfect; do past-paper practice so that the exam format is as familiar as possible. There are only a few ways in which you can be asked the same question, and you will see similar questions and diagrams appearing in many past papers. Doing a past paper against the clock will also help you to get your time management right.
- In the run up to the exams, eat plenty of fresh fruit and vegetables to keep your energy levels up, and make sure that you get a good night's sleep so that you are alert throughout the exam.
- Switch off all mobile devices and social media.

THE STRUCTURE AND AIMS OF THIS BOOK

There is no shortcut to passing any course at Higher level. To obtain a good pass requires consistent, regular revision over the duration of the course. The aim of this revision book is to help you achieve success by providing you with a concise and engaging coverage of the CfE Higher Human Biology course material. We recommend that you use this book in conjunction with your class notes, to revise each topic area, prepare for Unit Assessments, and other internal assessments, and in your preparation for the final exam.

The book is divided between the four units of the course. Within each section, there is a double-page spread on each of the sub-sections.

Each double-page spread:

- provides the key ideas and concepts of the sub-section in a logical and digestible manner
- contains 'Internet Links' and 'Don't Forget' boxes that flag up vital pieces of knowledge that you need to remember and important things that you must be able to do
- gives a link to an online test to test your knowledge and understanding of each topic
- ends with a 'Things To Do and Think About' feature which extends your knowledge and understanding of the subject, and provides additional interest. Sometimes there are questions to help you check your understanding.

Good luck, and enjoy!

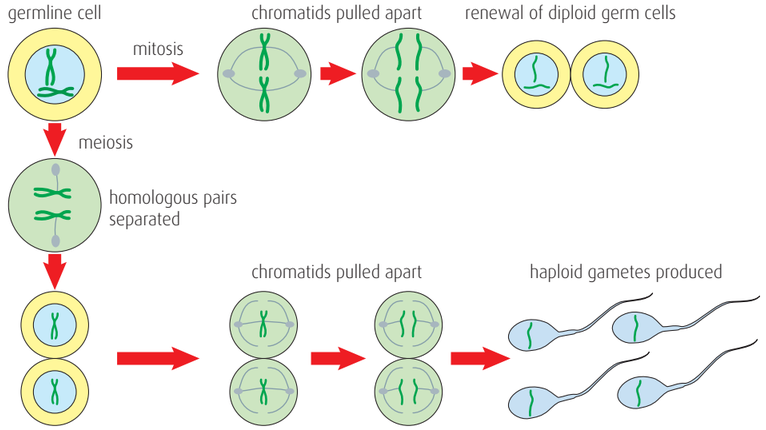
STEM CELLS

DON'T FORGET

Human diploid somatic cells have 23 pairs of chromosomes, i.e. 46 chromosomes.

GERMLINE CELLS

Germline cells are situated in the testes and ovaries. They can replace themselves by dividing by **mitosis** or they can produce haploid gametes by dividing by **meiosis**.



If a mutation occurs in a germline cell it will end up in gametes and may be passed on to offspring if fertilisation is successful.

STEM CELL RESEARCH

Stem cell research gives a better understanding of the control of gene expression and differentiation. Stem cells are also used to model cells and tissues, to study the effects of diseases or drug therapy. A limitation of this research is that it can't look at interactions within the organism. A key aim is to promote the therapeutic use of stem cells to replace damaged or diseased tissue. Stem-cell production is under strict control.

RESEARCH AND THERAPEUTIC USES OF STEM CELLS

Therapeutic value looks at the potential of stem cells in medicine. Stem cells are of special interest in the repair of diseased or damaged organs and to replace lost tissue.

Skin Grafts

If a person is badly burned, there may not be enough good skin to use in grafts. A solution is to remove some adult stem cells from an area of good skin. These can then be cultured in the laboratory to produce skin cells. The new skin is grafted onto affected areas on the patient. The skin will not be rejected but isn't perfect as it lacks the complexity of normal skin, not having hair follicles and sweat glands.

Bone Marrow Transplantation

Bone marrow stem cells are multipotent and can produce blood cells and platelets. Transplantation is used to treat certain types of blood-related cancers, leukaemia or sickle cell anaemia. The patient's own bone marrow stem cells are destroyed and then replaced with healthy bone marrow stem cells, either from a compatible donor or from the patient themselves (if healthy bone marrow was harvested previously).

contd

Cornea Repair

Damaged corneas are more usually removed and replaced with healthy corneas from dead donors. This procedure is tried and tested, but is invasive and there is a global lack of donors. Scientists have found that multipotent stem cells are located at the edge of the cornea. They can produce corneal or conjunctival cells. Stem cells can be removed from the patient's 'good' eye to be transplanted onto the damaged eye. Studies have included the use of contact lenses as culture media for the stem cells.

ETHICAL ISSUES OF STEM CELL USE

Certain control measures are in place to try to address some of the ethical implications of stem cell use.

Moral

Unused blastocysts from embryonic stem cell lines are destroyed as they are not allowed to develop beyond day 14. This is when the embryo would normally implant in the uterus leading to development of a foetus.

Health

A complete medical history of adult stem cell donors is required to minimise the chance of recipients developing other medical problems.

Safety

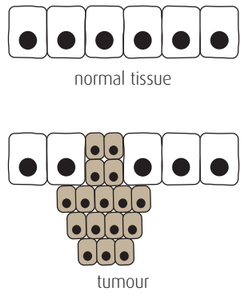
Stem cells must be safe to use in the treatment of patients: they should not cause other conditions or diseases such as tumours. It is for this reason that ongoing research and thorough testing is vital.

CANCER

Normal cells have a programmed lifespan and are replaced by cell division when they die, so that organs maintain both shape and function. A cancer cell does not undergo this pre-programmed 'death' but divides rapidly to form a space-occupying mass or tumour.

Healthy cells spend most of their lifecycle growing and performing their specialised roles. A short portion of their lifecycle is spent in mitosis. Checkpoints in the lifecycle ensure that that the cell has grown sufficiently and completed DNA replication before division. A cell undergoes a limited number of cell divisions before it dies. Some genes produce regulatory proteins that promote division and act like an accelerator, others stop or slow division and act like the brakes.

Cancer cells lack these controls because of mutations in the genes that control mitosis. The cells divide rapidly and form a tumour. A cancerous tumour has a blood supply that feeds the cells with nutrients and oxygen for rapid growth. Healthy cells normally stick to each other, but cancer cells lose this ability and separate. The blood vessels that supply them allow cells to escape and spread to other parts of the body to form secondary tumours.



THINGS TO DO AND THINK ABOUT

1 Where are germline cells located?

2 What is produced when germline cells divide by:
a mitosis? **b** meiosis?

3 Describe the mechanisms that cause the formation and spread of cancerous tumours.

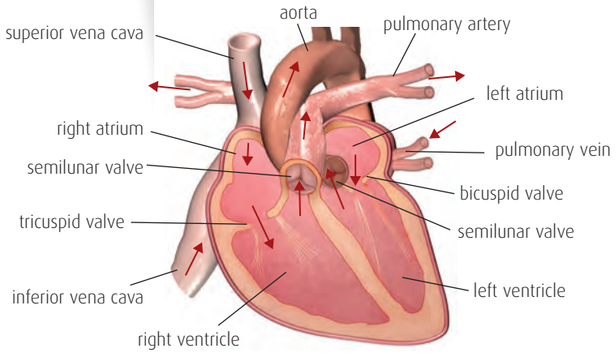
VIDEO LINK

Watch the animation on cancer formation at www.brightredbooks.net

ONLINE TEST

Test yourself on your knowledge of stem cells at www.brightredbooks.net

THE HEART



INTRODUCTION

The heart is the muscular organ which pumps blood around the body. It is often referred to as a double pump: the right side of the heart pumps deoxygenated blood to the lungs and the left side of the heart pumps oxygenated blood to all parts of the body. The heart is made up of four chambers: two **atria** that receive blood from the main veins and two **ventricles** that pump blood either to the lungs (right ventricle) or to the body (left ventricle). The heart muscle (cardiac muscle) is supplied by the **coronary arteries**. Valves within the heart are present to prevent backflow of blood.

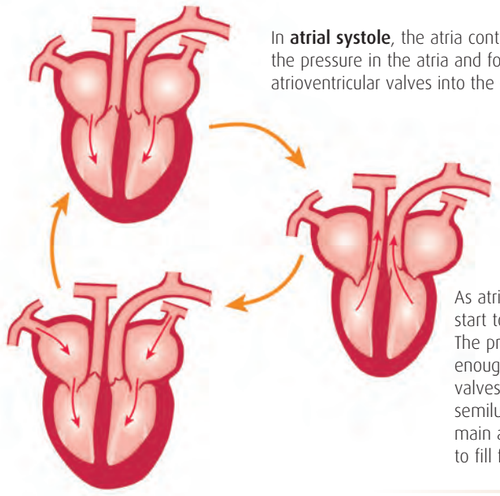
VIDEO LINK

Watch the animation of blood flow through the human heart at www.brightredbooks.net

Name of valve	Location	Phase of cardiac cycle when valve is closed	Function of valve
Atrioventricular valves (tricuspid and bicuspid)	Between the atria and ventricles	Ventricular systole	Prevent the backflow of blood into the atria
Semilunar valves	At the start of the pulmonary artery (on the right) and the aorta (on the left)	Atrial systole	Prevent the backflow of blood from the main arteries into the ventricles

CARDIAC CYCLE

The sequence of filing and emptying of the heart chambers is called the **cardiac cycle**. During the cardiac cycle, contraction and relaxation of cardiac muscle alters the blood pressure within each of the heart chambers, causing the correct flow of blood through the heart. Blood will always flow from high to low blood pressure unless a valve is closed, preventing blood flow. The cardiac cycle is divided into periods of relaxation (**diastole**) and periods of contraction (**systole**).

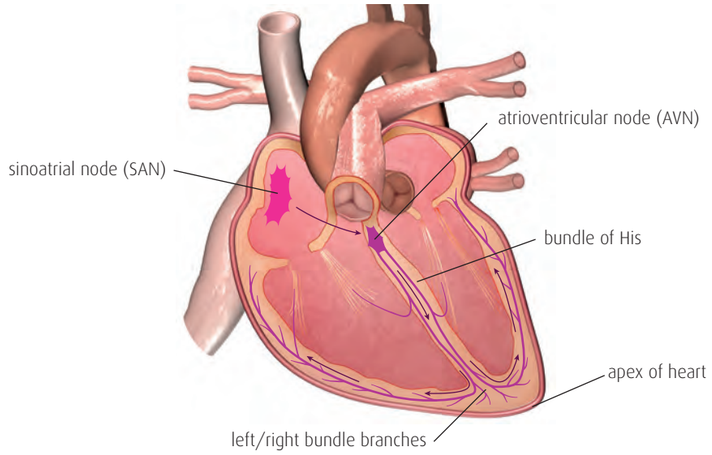


In **atrial systole**, the atria contract, futher increasing the pressure in the atria and forcing blood through the atrioventricular valves into the ventricles (which are relaxed).

In **diastole**, the ventricles relax, causing the pressure to drop below that of the main arteries, closing the semilunar valves (with a 'dup' sound). The atria are relaxed and continue to fill with blood from the vena cava and pulmonary vein, increasing the pressure above that of the ventricles. This forces the atrioventricular valves open, and the ventricles begin to fill.

As atrial systole ends, the ventricles start to contract (**ventricular systole**). The pressure in the ventricles increases enough to close the atrioventricular valves (with a 'lub' sound) and open the semilunar valves to force blood into the main arteries. The relaxed atria also begin to fill from the main veins.

CONTROL OF THE CARDIAC CYCLE



Although cardiac muscle is able to beat on its own, the contraction of each heart chamber must be coordinated to bring about the correct movement of blood.

Coordination of the cardiac cycle is brought about by the **conducting system** of the heart. Electrical excitement (a **cardiac impulse**) is initiated in an area of the right atrium called the **sinoatrial node (SAN)**, the pacemaker of the heart, where the cells are **auto-rhythmic**. From here, a wave of contraction moves out across the atria to reach the **atrioventricular node (AVN)** in the right atrium. The impulse passes down through a bundle of fibres in the central wall of the heart to reach the apex of the heart, then up through left and right branches to the walls of the ventricles. Ventricular contraction (systole) begins at the apex of the ventricles and spreads upwards to squeeze blood out of the ventricles towards the main arteries.

The heart rate is under both nervous and hormonal control.

- **Sympathetic nerves** increase the heart rate.
- **A parasympathetic nerve**, the vagus nerve, slows down the heart rate.
- The part of the brain controlling these nerves is called the **medulla oblongata**.
- **Noradrenaline (nor-epinephrine)** is released by the sympathetic accelerator nerves and speeds up the heart rate, and **acetylcholine** – released by parasympathetic nerves – slows the heart rate.

THINGS TO DO AND THINK ABOUT

Which line in the table correctly identifies the state of the heart valves during ventricular systole?

	Semi-lunar valves	Atrio-ventricular valves
A	open	open
B	open	closed
C	closed	open
D	closed	closed

ONLINE

For more on the human heart, follow the link at www.brightredbooks.net

DON'T FORGET

To follow the cardiac cycle, you only need to consider one side of the heart (as the right side is always at the same stage as the left side).

ONLINE TEST

Test your knowledge of the heart at www.brightredbooks.net

CONTROL OF INFECTIOUS DISEASES

There are several strategies which can prevent the spread of an infectious disease.

DON'T FORGET

The spread of an infection can be prevented by inhibiting or preventing the growth and multiplication of pathogenic microorganisms.

ONLINE

Read more about antisepsis at www.brightredbooks.net

STRATEGIES TO CONTROL INFECTION

1 Quarantine

An individual who is known to have a particular infection may be isolated from healthy people, in order to prevent the disease spreading. **Quarantine** is when a person who is known to have been **exposed** to a particular infection is kept in compulsory isolation for a period of time (the known incubation period for that particular type of infection). The aim of a period of quarantine is to prevent spread of infection. It separates those who are known to have been exposed (and who may or may not become ill) from those who are known to be healthy, in the hope of stopping further spread of disease.

2 Antisepsis

Prevention of the spread of infection is minimised during surgery by using sterile procedures: wearing a sterile gown, gloves and a mask, and all equipment is sterilised using heat treatment (boiling in water or autoclaving using steam). An antiseptic is a chemical which kills microorganisms and can be applied to the skin to reduce the chance of infection. Common antiseptics include alcohol, hydrogen peroxide and iodine, and there are many commercial liquids, creams, sprays and wipes available.

ONLINE

Read about the prevention of infection at www.brightredbooks.net

3 Individual Responsibility

Every individual can help prevent the spread of infection by being responsible for good hygiene, care in sexual health and through appropriate storage and handling of food.

Individual responsibility	Explanation/examples
Good hygiene	Washing hands, showering and the use of antibacterial hand gels can prevent transmission of pathogens from one host to another.
Care in sexual health	Using condoms during sex can prevent the spread of sexually transmitted infections.
Appropriate storage and handling of food	Keeping work surfaces, hands and utensils clean during preparation of food. Cooking food thoroughly. Only reheating food once. Storing food at the correct temperature. Storing raw and cooked food separately.

4 Community Responsibility

Larger communities, such as countries and local authorities, or smaller communities, such as towns or villages, can help prevent the spread of infection by ensuring a safe water supply, and by having appropriate waste disposal systems. Food webs must be kept free from harmful microorganisms during cultivation, harvesting and manufacturing processes, so that the food we eat is safe.

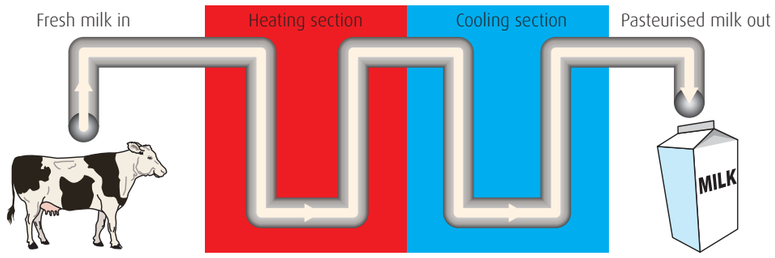

Water treatment plant


Sewage treatment plant

Community responsibility	Explanation/examples
Quality water supply	Water is **filtered** to remove any solid particles and treated with **chlorine** to kill pathogens.
Safe food webs	Milk is **pasteurised** to kill many microbes. Businesses which make or prepare food are **inspected** for hygiene, must carry out risk analysis of food and must ensure **traceability** (be able to identify their suppliers of food and the businesses to which they supply products).
Appropriate waste disposal systems	Waste water (sewage) is kept separate from the fresh water supply and is treated to kill harmful microbes. Dry waste is collected regularly and recycled, incinerated or buried.

ONLINE

Read about how Scotland's water and food webs are kept safe at www.brightredbooks.net



5 Vector Control

Controlling the vectors of disease can prevent the spread of infection. Malaria is a serious tropical disease caused by a protozoan parasite, the plasmodium, which is spread by the mosquito vector. When an infected mosquito bites a human, it passes the parasites into the bloodstream. Removing the mosquito vector is a key strategy in the control and eradication of malaria. This can be achieved by:

1. draining stagnant water to remove mosquito breeding grounds
2. introducing sterile male mosquitoes to reduce breeding rates
3. using chemicals such as insecticides and larvicides.

ONLINE

Read about how our food webs are kept safe at www.brightredbooks.net

DON'T FORGET

A vector is a living thing which can pass a pathogenic microorganism from one living thing to another

THINGS TO DO AND THINK ABOUT

1. Describe the meanings of: (i) quarantine and (ii) antisepsis.
2. Explain two ways in which you, as an individual, can prevent spread of infection by showing responsibility.
3. Explain two ways in which communities can act responsibly to prevent the spread of infection.
4. Explain what is meant by vector control.

ONLINE TEST

Revise your knowledge of controlling infectious diseases by taking the test at www.brightredbooks.net

BrightRED Study Guides

CfE HIGHER

HUMAN BIOLOGY

Cara Matthew, Angela Grant and Kathleen Ritchie

This BrightRED Study Guide is the ultimate companion to your CfE Higher Human Biology studies! Written by our trusted authors and experienced Human Biology teachers, Cara Matthew, Angela Grant and Kathleen Ritchie, this book is full-colour and packed with clear and accessible information, excellent examples, activities and advice. Inside, you will find:

- **All the essential course information** arranged in easily digestible double-page topic spreads.
- **Detailed full-colour diagrams, illustrations and data boxes** to make sure all that study sticks!
- ***Don't forget*** pointers offering advice on the key facts to remember, and on how to avoid common mistakes.
- ***Things to do and think about*** sections encouraging the regular review of key points covered.
- ***Digital Zone* activities and tests** to supercharge your learning efforts online!
- **An index** of key terms to help when revising.

Your future's bright with BrightRED Study Guides!

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