NATIONAL EXTENSION COLLEGE

Structured Fast Track

A level Biology

Course sample

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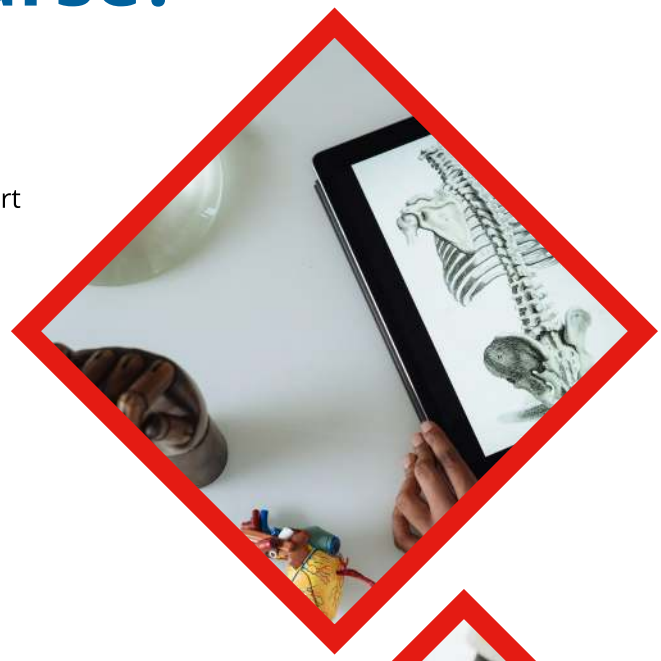

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Helen

Superb organisation from signing up to getting results. High quality resources with well linked assignments.

Ceebee

So what will a course topic look like?

Course content

NEC's Structured Fast Track A level Biology course will follow the same topics as Pearson Edexcel's biology A level but has a set schedule, allowing you to complete the course within one academic year rather than two.

Section 1: Lifestyle, health and risk

What is cardiovascular disease?

Who is at risk of cardiovascular disease?

Risk factors for cardiovascular disease?

Biochemistry involved in cardiovascular disease?

Reducing the risk of cardiovascular disease

Let's look at part of 'Topic 1: What is cardiovascular disease?'

Section 2: Genes and health

The effects of cystic fibrosis on the lungs

Why is CF mucus so sticky?

The roles of proteins and enzymes

How is the CFTR protein made?

How is cystic fibrosis inherited?

Testing for CF

Section 3: Voice of the genome

Cells and their components

In the beginning

From one to many: the cell cycle

How development is controlled

Genes and environment

Section 4: Biodiversity and natural resources

Why are there so many different species?

How did organisms become so well adapted?

Classification and speciation

Plant cells and tissues

Making use of biodiversity in plants

On the brink

Ecosystems rely on energy transfer
Global climate change
Predicting and coping with future climate change
Adapt or die
Getting the balance right

Section 6: Infection, immunity and forensics
Forensic biology
Cause of death
The body's response to infection
Could the infections have been prevented?
Are there treatments for AIDS and TB?

Section 7: Run for your life
Getting moving
Energy for action
Peak performance
Breaking out in a sweat
Overdoing it
Improving on nature

Section 8: Grey matter
The nervous system and nerve impulses
Reception of stimuli
The brain
Visual development and making sense of what we see
Learning and memory
Problems with synapses
Genetic modifications: risks and benefits

Topic 1

What is cardiovascular disease?

Introduction

Diseases of the heart and circulatory system are collectively known as cardiovascular disease (CVD). Heart disease and strokes, caused by CVD, are major causes of death and disability in the world today. What causes them and can anything be done to prevent them? This topic looks at the heart and **blood** system, how they work in a healthy body and what can go wrong to cause cardiovascular diseases.

You will probably need 4 hours to complete this topic.

Objectives

When you have completed this topic you should be able to:

- explain why many animals have a heart and circulation
- explain the importance of water as a solvent in transport
- describe how the structure of blood vessels relates to their functions
- describe the cardiac cycle and how the structure and operation of the mammalian heart relate to its function
- list the course of events that leads to atherosclerosis
- describe the blood clotting process and its role in cardiovascular disease.

What is cardiovascular disease?

Cardiovascular disease (CVD) is a term used to describe a disease of the circulatory system, which consists of the **heart** and **blood vessels**. **Blood** is a liquid tissue containing blood cells and dissolved substances that is pumped around the body by the heart. Movement of blood is an example of **mass flow**, the bulk transport of materials from a place of higher pressure (provided by the heart) to where pressure is lower.

Before you go on to look at the reasons why CVD develops, you need to learn why humans need a circulatory system and how it works.

In Topic 1 Section 1.1 of the textbook, read from the beginning to the heading *How does the circulation work?* including the *Key biological principle: Why have a heart and circulation?* Then do Activity 1.

Activity 1

(Allow 10 minutes)

1 Write a short summary explaining why many animals have a heart and circulation. Your summary should include an explanation of the concept of mass flow.

2 Suggest why only small animals have an open circulatory system.

3 What are the advantages for larger animals of having a double circulatory system?

1 Your summary should include these points:

- All cells need substances which they get by the process of **diffusion** through their cell membranes.
- Complex, **multicellular organisms** are too large for substances to diffuse through their skin and to reach all their cells quickly enough.
- Therefore substances need to be moved by mass flow – the bulk transport of materials from one point to another as a result of a pressure difference between the two points.
- Therefore substances are carried in blood.
- The heart generates the pressure to keep blood moving.

2 Circulation of body fluid in insects and other small animals is mainly in the body cavities surrounding organs. Diffusion of substances into and out of cells in these organs is only efficient over short distances, and would be too slow in larger animals.

3 The advantage of a double circulatory system is that blood can pass slowly through the region where gas exchange takes place, giving time for maximum transfer of oxygen and carbon dioxide, and then be pumped vigorously round the rest of the body, enabling the animal to be active.

Study hint

You may find it helpful to watch this short video showing a closed circulatory system.

https://www.youtube.com/watch?v=KCC_FrbuR3U
(1 minute 38 seconds)

How does the circulation work?

Because human beings are relatively large organisms, they need a complex and efficient system to move substances around their bodies. Next you will learn about the human circulatory system, which is made up of:

- blood – a liquid that contains dissolved substances being transported around the body
- blood vessels – blood travels in these
- heart – a pump that creates the pressure needed to keep the blood moving. Blood consists of a liquid **plasma**, cells (both red blood cells and white blood cells) and **platelets** (small fragments involved in clotting). The soluble substances being transported around the body are dissolved in the water of the plasma.

Study hint

You can learn more about the composition of blood here:
http://www.myvmc.com/anatomy/blood-function-and-composition/

Activity 2

(Allow 5 minutes)

List as many substances as you can think of that need to be moved around the body.

You could have included:

- nutrients, e.g. glucose and **amino acids**
- oxygen
- carbon dioxide
- waste substances, e.g. urea
- hormones.

These fit into four main categories:

- respiratory gases (oxygen and carbon dioxide)
- metabolites – substances which take part in metabolic reactions (e.g. glucose, amino acids)
- metabolic waste produced as a result of **metabolism**, that is, the chemical reactions in the body (e.g. urea)
- hormones (e.g. insulin).

Water as a solvent

Water is a very good solvent, being able to dissolve many different types of substances. This property is due to the structure of the water molecules and how they interact together and with other substances. Each water molecule consists of two hydrogen atoms joined to one oxygen atom. The electrons are not evenly spread over the molecule, with the result that the oxygen atom has a negative charge and the hydrogen atoms a positive charge. Molecules like this are called **dipoles**, or **polar** molecules.

Another useful property of water is that it has a high specific heat capacity, meaning that it is slow to warm up and cool down.

Molecules or parts of molecules that readily mix with water are called **hydrophilic**. These include salts, sugars and many proteins. Those that repel water are known as **hydrophobic**.

Study hint

To learn more about water and why it is so important to life, go to the PowerPoint called 'Water and life' which you will find in Section 1 of your online course.

You can find another useful PowerPoint at:

https://www.docslides.com/water-and-life

In Topic 1 Section 1.1 of the textbook, read the *Key biological principle: Properties of water that make it an ideal transport medium.*

Activity 3

(Allow approximately 10 minutes)

1 What is the name given to a molecule such as water which has a difference in electrostatic charge between one side of the molecule and the other?

2 What is the name given to the weak bonds by which water molecules are attracted to each other?

3 Why is water such a good solvent of ionic compounds such as salt (sodium chloride)?

4 Define the terms hydrophilic and hydrophobic.

5 Suggest an example of a substance whose molecules are hydrophobic.

1 A molecule of water is an example of a dipole or a polar molecule.

2 **Hydrogen bonds** attract polar molecules such as water to each other.

3 Ionic compounds, e.g. salts, dissolve in water because the small negative charges at the oxygen end of the water molecules are attracted to the positive ions and surround them. These water molecules are, in turn, surrounded by more water molecules attracted to them and so the ion is dissolved in the water. A negative ion similarly attracts the small positive charge of the hydrogen atoms in the water molecule.

4 Hydrophilic means 'water loving'. (This applies to molecules containing polar groups, e.g. –OH in sugars and $–NH_2$ in amino acids.) Hydrophobic means 'water-hating'.

5 Examples of substances which are hydrophobic, and therefore do not dissolve in water, include fats and oils, which have no or very few polar groups.

You now know that mammals have a double circulatory system. In the next part of this section you will be looking in more detail at the blood vessels that carry the blood to and from the heart.

Blood vessels

In order to understand how the heart works we first need to know how blood vessels work. Figures 1.10A and 1.10B in the textbook are diagrams showing the outside and inside of the heart respectively, with the blood vessels – the arteries and veins. We will be returning to these figures a little later.

First, you need to understand the differences between arteries, veins and capillaries.

Blood vessels are:

- **arteries** – carry blood from the heart
- **veins** – carry blood to the heart
- **capillaries** – very narrow vessels with thin walls, carrying blood to body tissues; they branch off from arteries and join to form veins.

Arterioles are small arteries formed after a larger artery divides, and **venules** are small veins that join to form a larger vein.

Each type of blood vessel has a different structure related to its function. The structures of the three main types of blood vessel are shown in Figure 1.11A in the textbook. Figure 1.11B is a photomicrograph showing a cross-section of a vein and an artery close together; the differences between the two blood vessels are clear.

Study hint

This short lecture makes use of a three-dimensional model of an artery and veins, clearly showing the differences in their structures:
https://www.youtube.com/watch?v=170ty_bkasU
(2 minutes 26 seconds)

In Topic 1 Section 1.1 of the textbook, read the section headed *The structure of blood vessels*, then do Activity 4.

Activity 4

(Allow 10 minutes)

Print or copy the table below.

1 How does the structure of an artery enable the artery to withstand high pressure and then recoil to maintain a steady flow of blood?

2 Complete the table comparing the three main types of blood vessel. We have completed some of the boxes to get you started.

Vessel	Artery	Vein	Capillary
Direction of blood flow (from–to)			From arteries to veins, through tissues
Function			Allows exchange of materials between blood and tissues
Structure of wall			
Presence of valves (Y/N)			

1 An artery has a thick layer of elastic fibres to allow expansion and recoil of the artery. This is surrounded by a thick layer of **collagen** fibres, which are tough and durable to withstand high pressure.

2 You will find the answer to Question 2 at the end of this topic.

Exam hint

In the exam, you will need to be able to recognise an artery and a vein from photomicrographs and drawings.

Check that you have understood the function and structure of the different blood vessels in Self check 1.

Self check 1

(Allow 10 minutes)

1 In which type of vessel is blood velocity the lowest and how does this help with the exchange of substances between the blood and tissue?

2 Which vessels have the thickest walls and why is this?

3 How does the structure of the capillaries relate to their role?

4 What is the function of the smooth muscle in the walls of arteries and some arterioles?

You will find feedback to self checks at the end of the section.

The heart is divided into two sides, left and right, and four chambers:

- two **atria**, one on the left and one on the right, which receive blood (from the lungs to the left atrium and from the systemic system to the right atrium)
- two **ventricles**, one on the left and one on the right, which pump blood out to the tissues.

Study hint

You may find it helpful to visualise blood flow through the heart by watching an animation. Here's an example.
https://www.youtube.com/watch?v=l7ejcLxKW8c
(2 minutes 26 seconds)

The left and right sides of the heart are completely separate.

The benefit of this arrangement is that it:

- keeps oxygenated and deoxygenated blood separate

- gives blood returning to the heart from the lungs an extra boost, which reduces the time it takes to circulate round the body.

The walls of the ventricles are composed of thick cardiac muscle which contracts to generate the pressures needed to move blood out of the heart. Between the atria and ventricles on both sides of the heart are valves held by tendons which prevent blood flowing back into the atria when the ventricles contract.

Look at Figure 1.10 again in the textbook and learn the labels.

Revision advice

When you are learning names of structures such as components of the heart, a good way to revise is to print an unlabelled diagram and see how many components you can label correctly. If you print several copies of unlabelled diagrams you can keep checking your answers and repeating as many times as you need to until you get them all right. To find an unlabelled diagram of the heart do a search online.

Learning the details of the heart's structure can be easier if you can see it. There are some good videos of heart dissection online. Try doing this in Activity 5. You might be able to have a go at dissecting an animal heart yourself.

Activity 5

(Allow 10 minutes for the video, longer if you dissect an animal heart)

Watch this video of a heart dissection:
https://www.youtube.com/watch?v=yE3Y-XR8Ax4
(4 minutes 10 seconds). This is from the At-Bristol Science Centre.

If you wish, you can have a go at dissecting an animal heart yourself. Hearts are available at butcher's shops and some supermarkets.

Safety

Take care when you are handling raw meat and sharp knives. Cover any cuts or grazes on your hands. Clean cutting boards and knives with hot water and disinfectant.

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