

The heart

Revision notes · Heart structure, how it pumps, monitoring heart rate, the effect of exercise, and coronary heart disease with its risk factors.

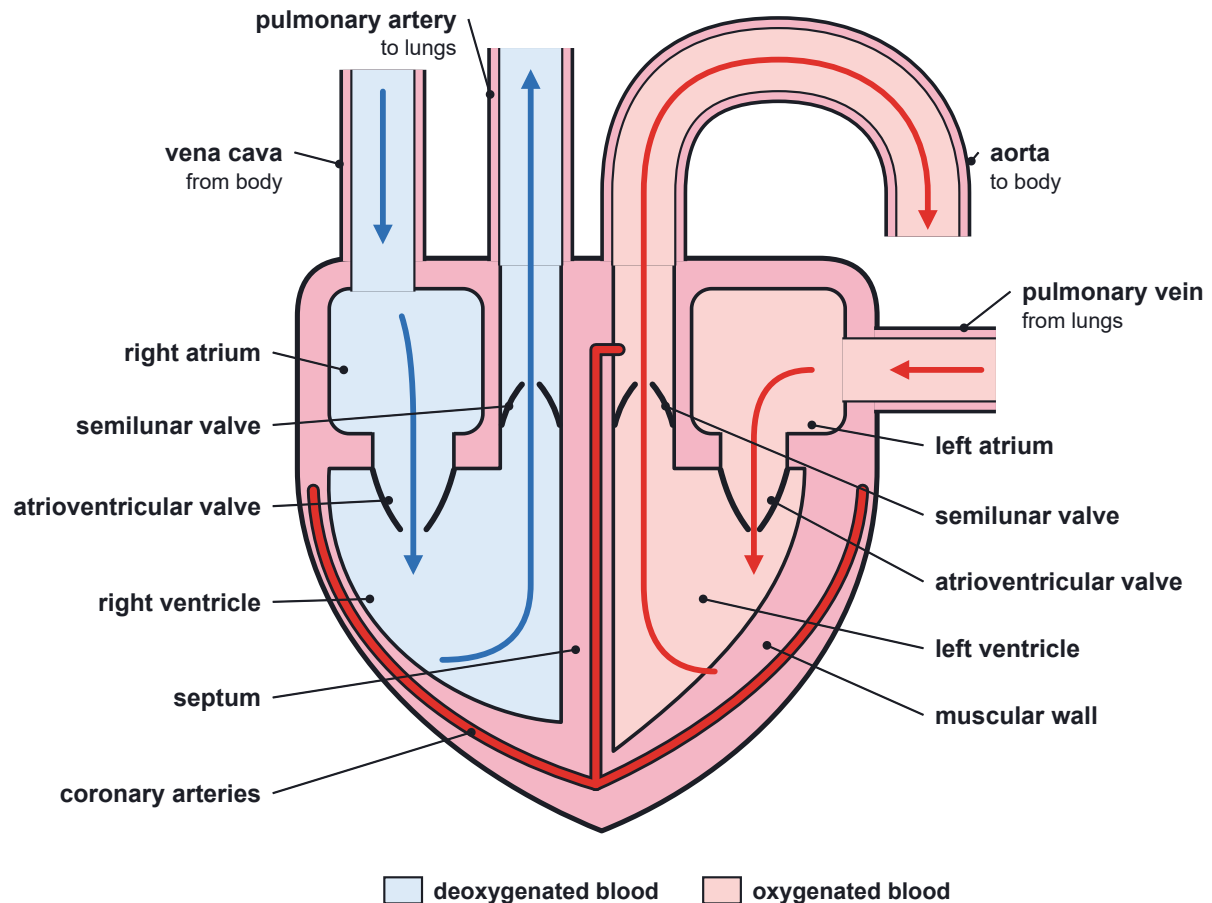
For Cambridge IGCSE Biology 0610 (and 0970, which has the same content). **Supplement** is Extended content, only examined on Papers 2 and 4.

The heart Spec 9.2

Structure of the heart Spec 9.2.1, 9.2.2, 9.2.7, 9.2.9

The mammalian heart is a pump made of cardiac muscle. You need to identify these structures in diagrams and images.

Structures of the heart	
Structure	What it is or does
Muscular wall	Contracts to squeeze blood out of the chambers
Right atrium and left atrium	Upper chambers that receive blood from veins
Right ventricle and left ventricle	Lower chambers that pump blood out into arteries
Septum	Wall of muscle between the left and right sides of the heart
One-way valves	Stop blood flowing backwards
Coronary arteries	Run over the surface of the heart and supply the heart muscle with oxygenated blood (oxygen and glucose)



The heart is drawn as if you are facing the person, so the **left side** of the heart is on the right of the page.

Blood is pumped **away from the heart in arteries** and **returns to the heart in veins**.

Supplement

Valves

Supplement

- The **atrioventricular valves** are between the atria and the ventricles.
- The **semilunar valves** are at the start of the aorta and the pulmonary artery, where blood leaves the ventricles.

Supplement

The septum

Supplement

The **septum** separates the left side of the heart from the right side. The right side holds deoxygenated blood and the left side holds oxygenated blood. The septum stops the two mixing, so blood sent to the body is fully oxygenated.

Common mistake: The heart is drawn as if you are facing the person. The left side of the heart is on the right of the page. The coronary arteries supply the heart itself, not the lungs.

How the heart pumps blood Spec 9.2.8, 9.2.10 Supplement

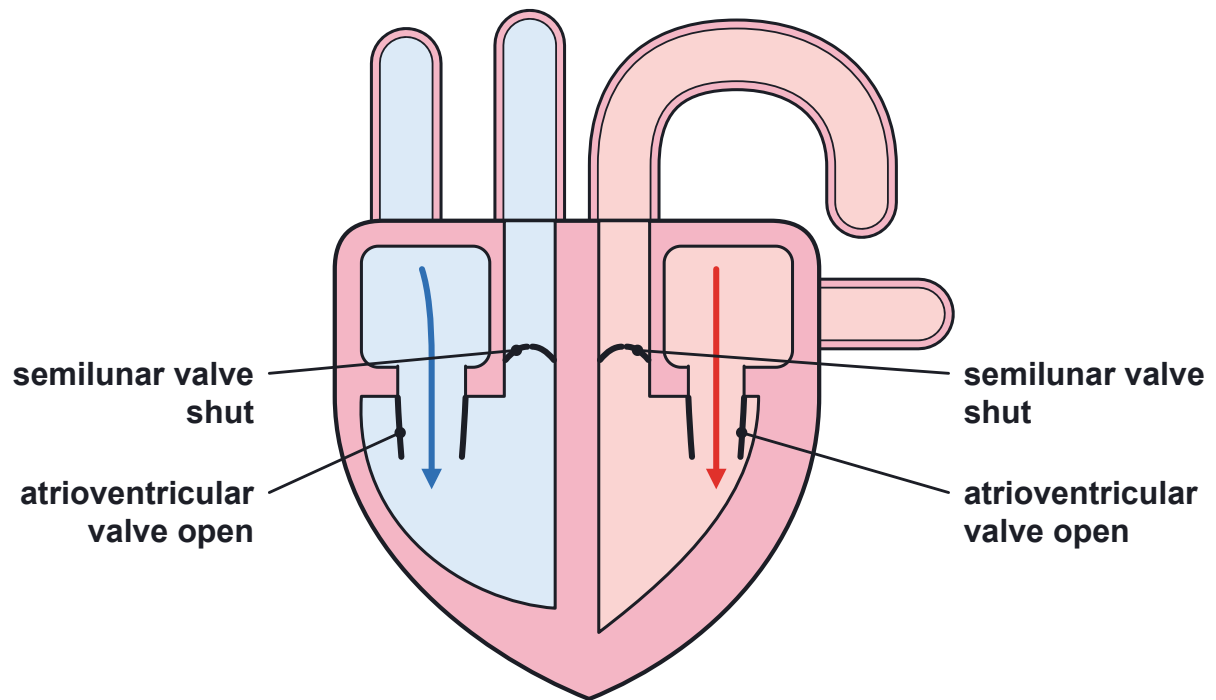
Thickness of the muscle walls

Wall thickness and function	
Comparison	Explanation
Left ventricle wall is thicker than right ventricle wall	The left ventricle pumps blood all around the body, so it must produce a high pressure . The right ventricle pumps blood only to the nearby lungs, at lower pressure that does not damage the lung capillaries
Atria walls are thinner than ventricle walls	The atria only push blood a short distance into the ventricles. The ventricles must push blood out of the heart and to the lungs or body

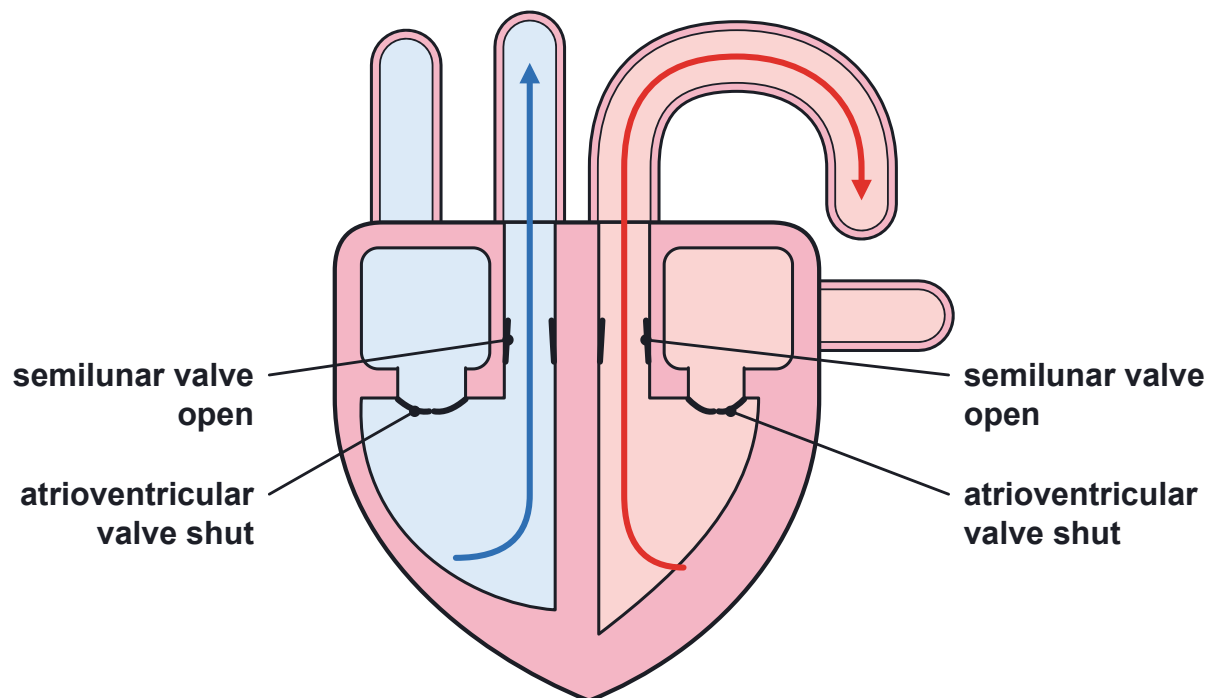
The pumping action

- 1 . Blood flows into the atria from the veins. The atria contract and push blood through the open **atrioventricular valves** into the ventricles.
- 2 . The ventricles contract. Pressure rises, the atrioventricular valves shut (stopping blood flowing back into the atria) and the **semilunar valves** open.
- 3 . Blood is forced out of the ventricles into the aorta and pulmonary artery.
- 4 . The ventricles relax. The semilunar valves shut, which stops blood flowing back into the ventricles. The atria fill again.

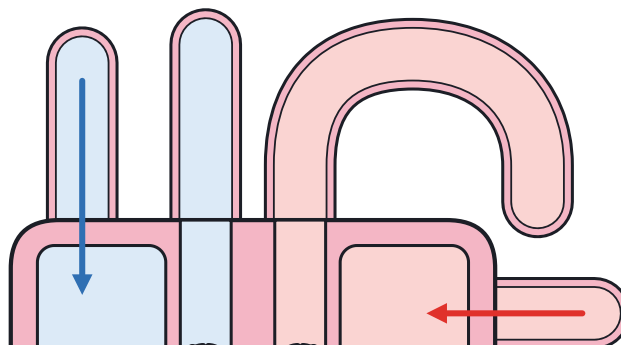
1 The atria contract

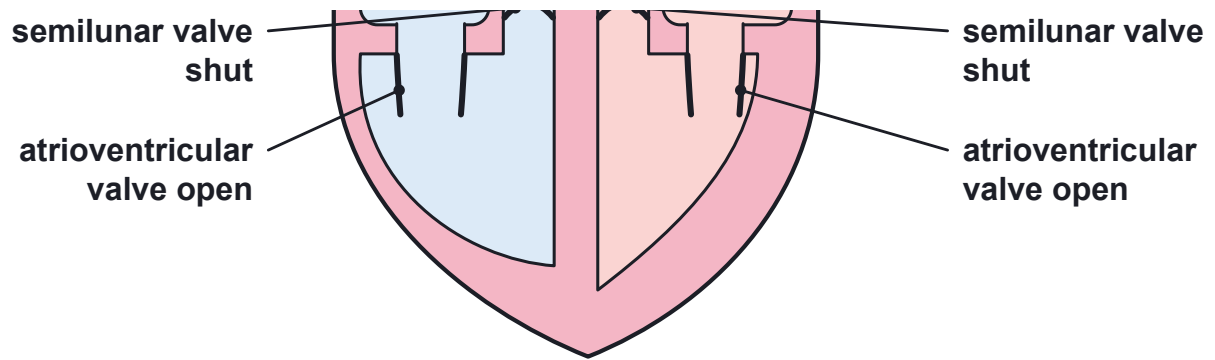


2 The ventricles contract



3 The heart relaxes and the atria fill





The valves open and shut because of **blood pressure**, so blood flows only one way.

Exam tip: The valves open and shut because of the pressure of the blood, not because the valves can contract. Say which valve and which way the blood is pushed.

Monitoring the heart and the effect of exercise Spec 9.2.3, 9.2.4, 9.2.11

The activity of the heart may be monitored in three ways.

- An **ECG** (electrocardiogram), which records the electrical activity of the heart.
- **Pulse rate**, felt at the wrist or neck, which is the number of beats per minute.
- **Listening to the sounds of the valves closing**, using a stethoscope.

Practical skill: Investigating the effect of physical activity on heart rate. Independent variable: the activity (for example, minutes of step-ups or jogging on the spot). Dependent variable: heart rate in beats per minute. Control: the same person, same time of day, same length of rest. Repeat and calculate a mean. Safety: stop if you feel dizzy or unwell, and do not take part if you have a heart or breathing condition.

1. Sit still for several minutes, then measure the resting pulse rate by counting beats for 15 seconds and multiplying by 4.
2. Do a set exercise for a fixed time, for example 2 minutes of step-ups.
3. Measure the pulse rate immediately after exercise.
4. Keep measuring every minute until the pulse returns to the resting rate. Record the recovery time.
5. Repeat with a different level of exercise and compare.

Calculating heart rate from a pulse count

A student counts 19 beats in 15 seconds. Calculate the heart rate in beats per minute.

1. 15 seconds is one quarter of a minute
2. heart rate = 19×4

Answer: 76 beats per minute

Typical results: heart rate rises during exercise and returns to the resting rate during recovery. The harder the exercise, the higher the rate and the longer the recovery.

Supplement

Explaining the effect of exercise

Supplement

During physical activity the muscles respire faster, so they need more oxygen and glucose and produce more carbon dioxide. Heart rate increases so that blood flows faster and:

Supplement

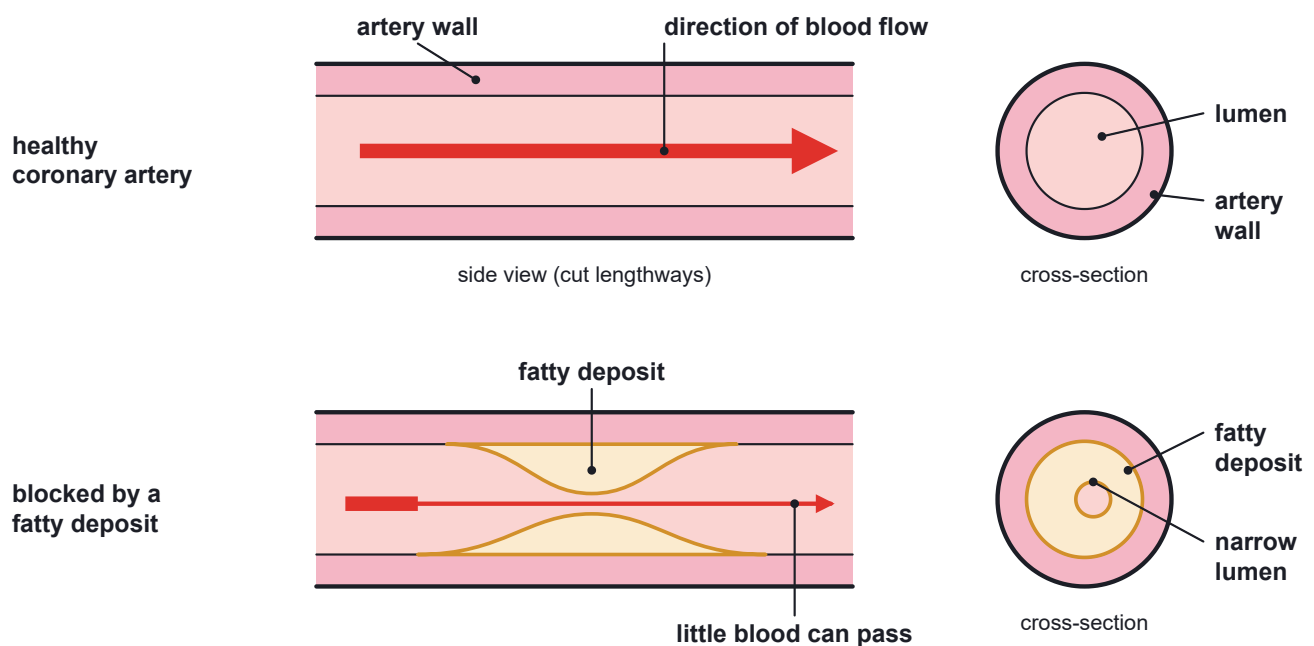
- more oxygen and glucose are delivered to the muscles for aerobic respiration
- carbon dioxide is removed more quickly, and lactic acid is carried away from the muscles if anaerobic respiration has happened

Supplement

Common mistake: Heart rate does not rise to 'give the muscles energy'. It rises to deliver oxygen and glucose faster and to remove carbon dioxide.

Coronary heart disease Spec 9.2.5, 9.2.6

In **coronary heart disease** (CHD) the **coronary arteries are blocked** by fatty deposits. Less blood reaches the heart muscle, so it receives less oxygen and glucose. If an artery is completely blocked, part of the heart muscle cannot get enough oxygen to respire, and a heart attack results.



A **fatty deposit** narrows the lumen, so less blood reaches the heart muscle.

Risk factors

- Diet, especially one high in saturated fat
- Lack of exercise
- Stress
- Smoking
- Genetic predisposition (family history)
- Age (risk increases with age)
- Sex (men are more at risk than women of the same age)

The roles of diet and exercise

Reducing the risk of CHD

Factor	How it reduces the risk
Diet	Eating less saturated fat reduces the fatty deposits in the arteries. Eating less salt and more fruit, vegetables and fibre helps keep the arteries and blood pressure healthy
Exercise	Regular exercise strengthens the heart muscle, helps to control body mass and lowers blood pressure, so the risk of blockage is lower

Exam tip: 'Discuss' means give both sides. For diet and exercise, say what each does, and also that other risk factors such as age and genes cannot be changed.

Quick check

1. **Supplement** What is the septum?
2. Name the vessels that supply the heart muscle with blood.
3. **Supplement** Why is the wall of the left ventricle thicker than that of the right ventricle?
4. State three ways of monitoring the activity of the heart.
5. State two risk factors for coronary heart disease.

Quick check answers

The heart

1. The wall of muscle separating the left and right sides of the heart.
2. The coronary arteries.
3. It pumps blood to the whole body at higher pressure; the right pumps only to the lungs.
4. ECG, pulse rate, listening to the sounds of the valves closing.
5. Any two of: diet, lack of exercise, stress, smoking, genetic predisposition, age, sex.