Start, delay, then coordinate

The heartbeat is myogenic: its normal rhythm begins within specialised cardiac muscle tissue, rather than requiring an external nerve impulse for every beat.

1. FOLLOW THE ELECTRICAL SEQUENCE

1. **SAN: initiate**

   The sinoatrial node, in the right atrial wall near the superior vena cava, generates an electrical wave. It is the normal pacemaker.

2. **Atria: spread and contract**

   Excitation spreads across both atria, triggering atrial systole. Blood is pushed through open AV valves into the relaxed ventricles.

3. **AVN: delay**

   The atrioventricular node briefly slows conduction. Atrial contraction can finish before ventricular contraction begins.

4. **Septal pathway: conduct down**

   The impulse passes into the bundle of His and its branches, which conduct it down the interventricular septum towards the apex.

5. **Purkyne tissue: spread rapidly**

   The conducting network distributes excitation through ventricular muscle. Coordinated ventricular contraction then ejects blood.

2. CONDUCTING CELLS ARE NOT NERVES

The SAN, AVN and Purkyne tissue contain specialised cardiac muscle cells. They initiate or conduct electrical excitation; ordinary contractile cells provide most of the pumping force. The wave is a change in cell membrane electrical state, not an impulse travelling in the blood.

Purkyne tissue is also called Purkinje fibres. This summary focuses on intrinsic coordination; nervous and hormonal control are outside this syllabus outcome.

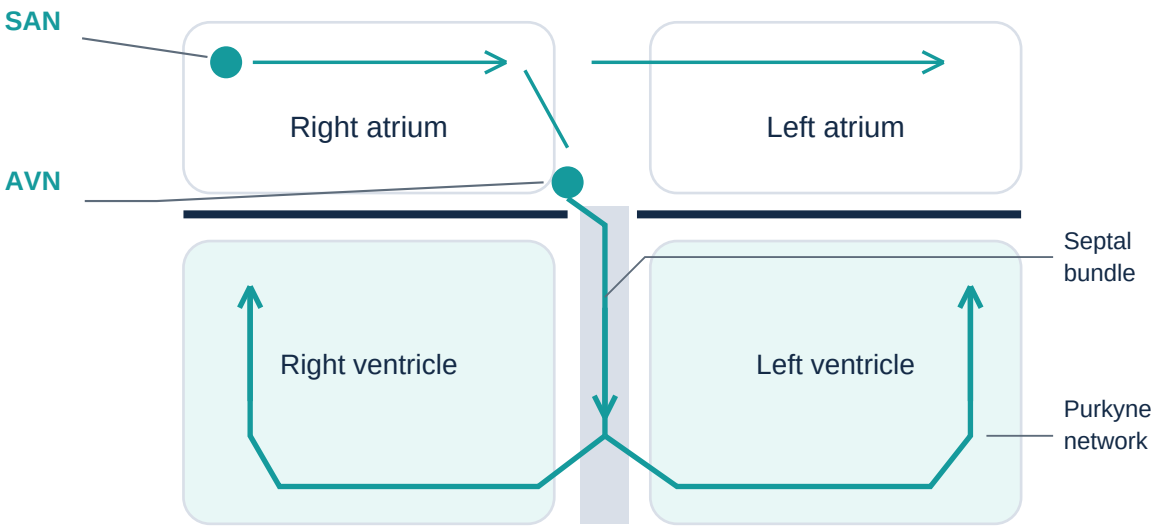
SAN, AVN and sequential activation: NHLBI, How the Heart Beats.
Specialised conducting cells and pathway: Klabunde, Normal Electrical Conduction.

Scope: Cambridge Biology 9700 syllabus, section 8.3, outcome 4, p. 28.

Locate the pathway in the heart

Fibrous tissue (dark bars) electrically insulates atria from ventricles. The normal route crosses via the AVN and bundle of His. Arrows show excitation, not blood flow; chamber shapes are schematic.

1. A SIMPLIFIED CONDUCTION MAP



2. THE AVN DELAY PROTECTS FILLING TIME

Insulating tissue prevents an immediate wave spreading directly from atrial muscle to ventricular muscle. Slower conduction at the AVN creates a brief delay, so the atria finish adding blood before ventricular pressure rises and the AV valves close.

3. APEX FIRST, TOWARDS THE BASE

Rapid conduction carries the signal down the septum before it spreads through ventricular walls. In the simplified teaching sequence, contraction progresses from near the apex upwards towards the base, helping drive blood into the aorta and pulmonary trunk. The anatomical base is the broad upper region, not the lower tip.

Insulation, AVN delay and conducting bundle: Klabunde, Normal Electrical Conduction.
Apex-to-base activation: OpenStax Anatomy & Physiology 2e, section 19.2.

Scope: Cambridge Biology 9700 syllabus, section 8.3, outcome 4, p. 28.

Electrical signal to blood flow

Electrical excitation triggers muscle contraction. Contraction changes chamber pressure, and pressure differences move the valves. Keep these events in the correct causal order.

1. CONNECT THE ELECTRICAL AND MECHANICAL EVENTS

Excitation	A wave spreads through cardiac muscle.
↓	
Contraction	Muscle develops force; ventricular pressure rises.
↓	
Valve response	AV valves close; semilunar valves open later.
↓	
Ejection	Blood enters arteries once ventricular pressure is higher.

2. THREE STRUCTURES, THREE DISTINCT JOBS

SAN: normally initiates the rhythm. AVN: delays transmission so atria contract before ventricles. Purkyne tissue: rapidly distributes excitation to coordinate ventricular contraction. A list of names is not enough; link each structure to the timing or pumping benefit.

3. DO NOT CONFUSE SIGNALS WITH VALVES

The AVN is conducting tissue, not an atrioventricular valve. Purkyne fibres do not pull semilunar valves open. Ventricular pressure must first exceed arterial pressure. An electrical event precedes its mechanical effect; the two are connected but not identical.

Myogenic does not mean every adult heart muscle cell normally acts as an independent pacemaker. The SAN sets the normal rhythm, and coordinated spread organises the contraction of the other cells.

Electrical excitation and muscle response: OpenStax Anatomy & Physiology 2e, 19.2.
Pressure-dependent valves and ejection: OpenStax, section 19.3.

Scope: Cambridge Biology 9700 syllabus, section 8.3, outcome 4, p. 28.