One heartbeat, a repeating cycle

Systole means contraction; diastole means relaxation. Always name the chambers: during atrial systole the ventricles are still in diastole. AV means atrioventricular.

1. FOLLOW THE SEQUENCE

1. **Passive filling**

   Atria and ventricles relaxed. Atrial pressure exceeds ventricular pressure: AV valves open; semilunar valves closed.

2. **Atrial systole**

   Atrial contraction raises atrial pressure and completes filling through open AV valves. Semilunar valves remain closed.

3. **Early ventricular systole**

   Ventricular pressure rises above atrial pressure, closing AV valves. Semilunar valves are still closed: no blood is ejected yet.

4. **Ventricular ejection**

   Ventricular pressure exceeds arterial pressure. Semilunar valves open; blood enters the arteries. AV valves remain closed.

5. **Early ventricular diastole**

   Ventricles relax. Arterial pressure exceeds ventricular pressure, closing semilunar valves. AV valves are initially still closed.

As ventricular pressure falls below atrial pressure, AV valves reopen and passive filling resumes. Return to step 1; there is no unique starting point to a cycle.

2. PRESSURE DIFFERENCES DRIVE THE VALVES

Blood moves down a pressure gradient when a route is open. Valve flaps respond passively to this pressure difference, permitting forward flow and preventing backflow. Atria continue receiving venous blood while the ventricles contract.

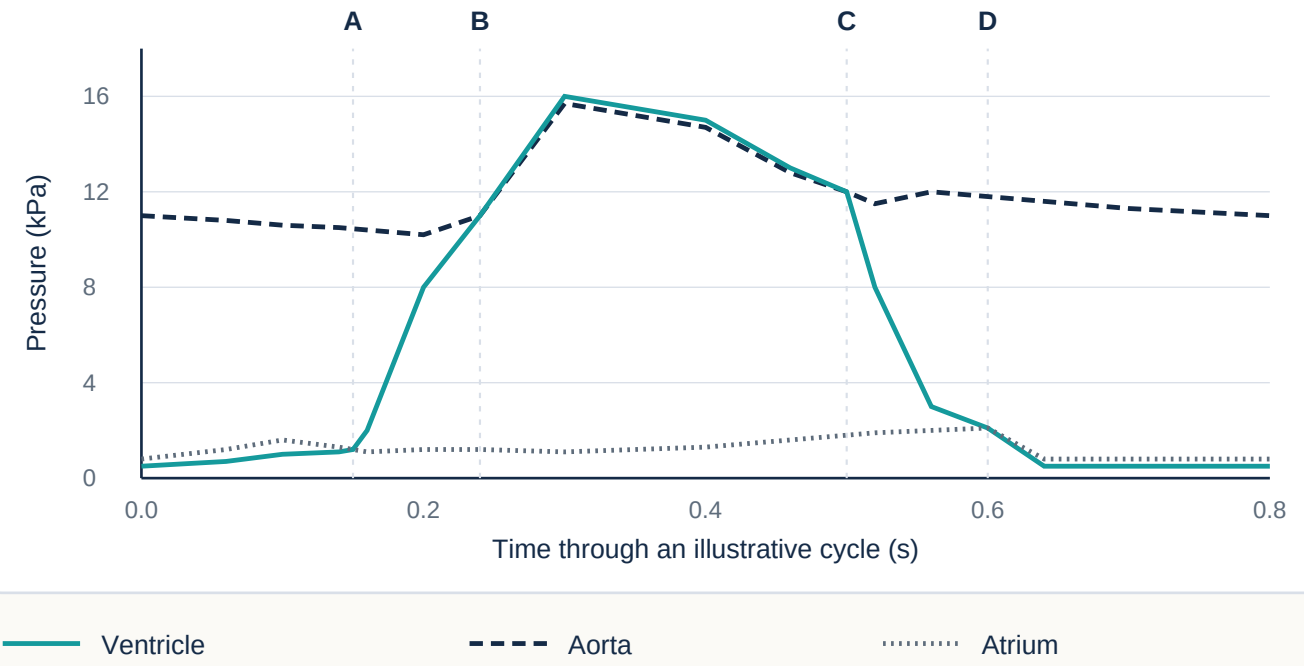
Contraction, relaxation and filling: OpenStax Anatomy & Physiology 2e, section 19.3.
Chamber sequence and venous return: Klabunde, Cardiovascular Physiology Concepts.

Scope: Cambridge Biology 9700 syllabus, section 8.3, outcome 3, p. 28.

Read the pressure crossings

Use the pressure difference across a valve, not the highest point on a curve, to identify opening or closure. This example follows the left atrium, left ventricle and aorta.

1. LEFT-SIDE PRESSURES THROUGH ONE CYCLE



Schematic curves, not experimental data. Timing and amplitudes are illustrative; fine atrial waves are simplified. Read the order of crossings, not exact values.

2. CONNECT EACH CROSSING TO A VALVE EVENT

A	Ventricle rises above atrium	Mitral (AV) closes
B	Ventricle rises above aorta	Aortic semilunar opens
C	Ventricle falls below aorta	Aortic semilunar closes
D	Ventricle falls below atrium	Mitral (AV) opens

A to B and C to D: both valve sets are closed. B to C: ejection. D onwards: filling. The right side follows the same pressure-based logic at lower pressures.

Pressure traces and valve events: Klabunde, Cardiovascular Physiology Concepts.
Cycle interpretation: StatPearls, Physiology, Cardiac Cycle.

Scope: Cambridge Biology 9700 syllabus, section 8.3, outcome 3, p. 28.

Valves explain volume changes

An open valve allows flow; a closed valve blocks it. During the brief closed-valve intervals, ventricular pressure changes even though ventricular blood volume stays constant.

1. MATCH VALVE STATE TO VENTRICULAR VOLUME

Phase	AV	Semilunar	Volume
Filling / atrial systole	Open	Closed	Rises
Early contraction	Closed	Closed	Constant
Ejection	Closed	Open	Falls
Early relaxation	Closed	Closed	Constant

2. ISOVOLUMETRIC DOES NOT MEAN INACTIVE

Isovolumetric means unchanged volume. During early contraction, AV valves have shut but semilunar valves have not opened: pressure rises. During early relaxation, semilunar valves have shut but AV valves have not opened: pressure falls. No ventricular filling or ejection occurs in either interval.

3. KEEP THE TRANSITIONS IN ORDER

Do not say semilunar valves are open throughout ventricular systole, or AV valves throughout ventricular diastole. Each phase starts with a short closed-valve interval. Ventricles also retain some blood after ejection; they do not empty completely.

Supporting link: the first heart sound ("lub") is associated with AV valve closure; the second ("dub") with semilunar valve closure. Electrical coordination of the cycle follows in Lesson 8.3.4.

Early contraction and first sound: Klabunde, Isovolumetric Contraction (phase 2).
Early relaxation and second sound: Klabunde, Isovolumetric Relaxation (phase 5).

Scope: Cambridge Biology 9700 syllabus, section 8.3, outcome 3, p. 28.