Heart's power comes from two pumping chambers (ventricles), which contract to squeeze blood from arteries. Atria act as reservoirs for blood. Heart beat cycle has 2 main phases: systole and diastole. The whole cycle takes 1 second.

**Systole:** ventricular contraction
**Diastole:** ventricular relaxation

1. **Late diastole (relaxation):** muscular walls of heart relax - atrial chambers balloon as they fill with blood from main veins (low pressure) - some blood in atria flows into ventricles - by end of phase, ventricles fill to 80% capacity
2. **Sinus node is inactive during most of diastole until it sends a wave of electrical impulses as systole approaches**
3. **Atrial systole (contraction):** electrical impulses spread through atrial walls and stimulate contraction of cardiac muscle - blood squeezed through atrioventricular valves into ventricles, which remain relaxed
4. **Impulses travel through atrial muscles making them contract in 0.1 seconds - some signals pass along conducting fibers to atrioventricular node**
5. **Ventricular systole (contraction):** most active and powerful stage of cycle - thick cardiac muscle in ventricular walls contracts because of electrical impulse from atrioventricular node - ventricular pressure rises - semilunar valves open at exit of ventricles - blood forced into main arteries - atrioventricular valves snap closed
6. **Atrioventricular node sends impulses along conducting fibers within the septum to the lower ventricles and up through ventricle muscle**
7. **Early diastole (relaxation):** ventricular walls begin to relax - ventricular pressure reduces - pressure of recently ejected blood in main arteries is high - both semilunar valves closed, preventing backflow into ventricles - as ventricular pressure on atrioventricular valves relaxes, valves open - pressure is reduced in atria, allowing blood to enter from main veins
8. **Impulses spread through ventricular walls back toward atria within 0.2 seconds of leaving sinoatrial node (continues firing to continue cycle)**

---

**Electrical Conduction in Heart**

**Sinoatrial (SA) node:**
- located in the upper right atrium
- acts as the heart's natural pacemaker
- generates electrical impulses that spread throughout the heart

**Atrioventricular (AV) node:**
- located at the lower part of the interatrial septum
- acts as a safety valve, slowing down the rate of impulse transmission

**Bundle of His:**
- transported in the interventricular septum
- divides into the right and left bundle branches
- distributes electrical signals to the ventricles

**Conducting Fibers:**
- Purkinje fibers:
  - signal travel to the ventricles
  - rapid transmission

**Heart Rate Control**

- **Natural Intrinsic Rhythm:**
  - 60 to 100 BPM

- **Cardiovascular System:**
  - Modulation of heart rate by the autonomic nervous system
  - Sympathetic Activation:
    - Increases heart rate
    - Causes vasoconstriction
  - Parasympathetic Activation:
    - Decreases heart rate
    - Causes vasodilation

- **Hormonal Influence:**
  - Adrenaline, noradrenaline, and dopamine: increase heart rate
  - Estrogen, progesterone, and insulin: decrease heart rate

---

**Conducting Fibers**
- Conductions myocardial Purkinje fibers: heart's conducting fibers that are specialized long, thin cardiac muscle cells. They convey electrical impulses across heart.

**SA Node:**}
- Generates electrical impulse that initiates cardiac contraction in atrium.

**AV Node:**
- Receives signal from SA node, stimulates ventricular contraction.

---

**Heart Rate Control**
- Natural intrinsic rhythm is 60-100 BPM.
- Cardiovascular system modulates heart rate through the autonomic nervous system.
- Sympathetic stimulation increases heart rate.
- Parasympathetic stimulation decreases heart rate.
- Hormones like adrenaline also influence heart rate.
An ECG and EKG graphically record the electrical activity of the heart. A typical ECG records three waves, each representing different phases in the cardiac cycle.

**P** atrial depolarization: impulses spread across atria
- 1. blood returns to heart into atria
- 2. AV valves open and blood flows into ventricles
- 3. atrial contraction

**QRS** ventricular depolarization: impulses travel through ventricles
- 1. ventricles contract
- 2. AV valves close; first sound heard
- 3. ventricular systole
  - 1. pressure rises in ventricles
  - 2. blood forced through semilunar valves
  - 3. blood flows into aorta and pulmonary trunk

**T** ventricular repolarization: ventricles return to resting state
- 1. ventricles relax and pressure falls
- 2. blood flowing back from arteries closes semilunar valves; second heart sound heard
- 3. blood begins to fill atria again; cycle repeats