Your body resembles a large roadmap. There are routes or "arteries" that take you downtown to the "heart" of the city and "veins" that take you to the outskirts of town.

**Cardiac Conduction System**
- Cardiac muscle tissue exhibits **autorhythmicity** = generates its own stimulation.
- This is possible because of an internal cardiac conduction system which can initiate and distribute electrical impulses.

**Cardiac Conduction System**
- Comprised of interconnected structures
  - Sinoatrial (SA) Node
  - Atrioventricular (AV) Node
  - Atrioventricular Bundle
  - Bundle Branches
  - Purkinje Fibres

**Sinoatrial (SA) Node**
- Natural Pacemaker
- Upper RA
- Neuromyocardial cells
- Sympathetic & parasympathetic
  - Sympathetic ↑HR
  - Parasympathetic ↓HR

**Atrioventricular (AV) Node**
- Junction of atria and ventricles
- Spread of depolarisation - from atrial myocardium
- Delay 0.15 seconds
  - Time atria to expel blood
  - Time for ventricular filling
  - Protection to ventricles
- Less autonomic nervous control than SA node
  - Sympathetic ↑conduction time
  - Parasympathetic ↓conduction time

**Linked to the nervous system**
- Sympathetic and parasympathetic branches connect to the heart, influencing heart rate and rhythm.
The Heart: Regulation of Heart Rate

• Stroke volume usually remains relatively constant
  – Starling’s law of the heart — the more that the cardiac muscle is stretched, the stronger the contraction

• Changing heart rate is the most common way to change cardiac output

The Heart: Regulation of Heart Rate

• Increased heart rate
  – Sympathetic nervous system
  • Crisis
  • Low blood pressure
  – Hormones
    • Epinephrine
    • Thyroxine
  – Exercise
  – Decreased blood volume

The Heart: Regulation of Heart Rate

• Decreased heart rate
  – Parasympathetic nervous system
  – High blood pressure or blood volume
  – Decreased venous return

Blood vessels and blood cells:
The body’s transportation system

Blood Vessels: The Vascular System

• Taking blood to the tissues and back
  – Arteries
  – Arterioles
  – Capillaries
  – Venules
  – Veins

Blood Vessels: One Way Streets

Blood Vessels resemble very long and skinny tunnels that are all through your body

Arteries carry blood away from the heart

Veins carry blood to the heart

Capillaries connect the two and are the drop off & pick up point
Why do you think the muscle is so much thicker in the artery?

The elastic fibers increase its elastic strength & the smooth muscles can change the diameter of the lumen.

Why would the diameter of the lumen need to be changed?

Semi-lunar valves stop the backflow of blood.

The leg and abdominal muscles help blood flow upwards from the feet to the heart.

A Vein –

note the thin wall and the semi-lunar valve.

Where substances enter & leave the blood:

Capillaries

Artery

Tissue cells

Venule

Large surface area to volume ratio allows rapid diffusion of substances between blood and cells.

No cell in the body is more than 2 cells away from a capillary.

Wall is single layer of highly permeable endothelium.

Approximately 10 micrometers in diameter.

The Vascular System
Capillary Exchange

- Substances exchanged due to concentration gradients
  - Oxygen and nutrients leave the blood
  - Carbon dioxide and other wastes leave the cells

Gas Exchange

Major Arteries of Systemic Circulation

Major Veins of Systemic Circulation

Pulse

- Pulse – pressure wave of blood
- Monitored at "pressure points" where pulse is easily palpated

Blood Pressure

- Measurements by health professionals are made on the pressure in large arteries
  - Systolic – pressure at the peak of ventricular contraction
  - Diastolic – pressure when ventricles relax
- Pressure in blood vessels decreases as the distance away from the heart increases
Variations in Blood Pressure

- **Human normal range is variable**
  - Normal
    - 140–110 mm Hg systolic
    - 80–75 mm Hg diastolic
  - Hypotension
    - Low systolic (below 110 mm HG)
    - Often associated with illness
  - Hypertension
    - High systolic (above 140 mm HG)
    - Can be dangerous if it is chronic

Developmental Aspects of the Cardiovascular System

- A simple “tube heart” develops in the embryo and pumps by the fourth week
- The heart becomes a four-chambered organ by the end of seven weeks
- Few structural changes occur after the seventh week