12.2
MONITORING THE HUMAN CIRCULATORY SYSTEM
THE HEARTBEAT
SINOATRIAL NODE (SA NODE)

- The pacemaker
- Stimulates muscle cells to contract and relax rhythmically
- In right atrium
- Generates an electrical signal, spread over the atria
- Atria contract simultaneously
- → atrioventricular node (AV node)
ATRIOVENTRICULAR NODE (AV NODE)

- Signal from SA node → AV node → bundle of His → Purkinje fibres
- → initiate simultaneous contraction of the ventricles
THE HEARTBEAT

- “lub-DUB”
- Made as valves close
- “lub” – closing of AV valves
- “DUB” – closing of semilunar valves
- Sound variations indicate heart problems
- eg. Stenosis murmur, narrowing of valve or artery
ELECTROCARDIOGRAM (ECG)

- Measure the electrical pulses (nerve signals stimulate contractions)
- Create millivolt charges
- Detect with electrodes on the skin
- Check signal for strength, frequency, and duration
ECG

Atrial excitation begins, atria contract.

Impulse delayed at AV node, ventricles fill.

Ventricular excitation in heart apex. Bicuspid and tricuspid valves close.

Ventricular excitation complete.

Ventricular relaxation. Semilunar valves close.

ECG:
P
Q
R
S
T

“Lub”

“DUB”
BLOOD PRESSURE

- Blood exerts pressure on the blood vessel walls as it travels.
- Changes correspond to phases of the heartbeat.
- Systolic pressure
  - Maximum pressure in arteries.
  - Ventricles contract and push blood through.
- Diastolic pressure
  - Lowest pressure in arteries.
  - Ventricles are not contracting.
(A) Small muscles surrounding the veins contract and relax to squeeze blood along the veins. (B) One-way valves inside the veins prevent blood from flowing backward due to the pull of gravity.
MEASURING BLOOD PRESSURE

- Sphygmomanometer
- blood pressure cuff
- Placed on artery in the arm
- mmHg
- Systolic over diastolic (120 mmHg / 80 mmHg)
BLOOD PRESSURE

- Affected by:
  - Genetics
  - Activity
  - Stress
  - Body temperature
  - Diet
  - Medications

- Hypertension (high blood pressure)
  - can damage arteries
  - Increase risk of heart attack, stroke, kidney failure
CARDIAC OUTPUT

- Blood volume pumped by the heart (mL/min)
- Indicates:
  - total level of work body’s muscles can perform
  - How easily heart fills with blood
  - Distensibility (stretchiness) of ventricles
- Calculated by (heart rate x stroke volume)
- Stroke volume: blood volume pumped out of heart with each heartbeat
- Eg: average heart rate is 70 bpm and stroke volume is 70 mL
- Average cardiac output = 70 x 70 = 4900 mL/min
CARDIOVASCULAR FITNESS

- Capacity of the lungs, heart, and blood vessels to deliver oxygen to working muscles
- Who is the most fit?

<table>
<thead>
<tr>
<th>Individual</th>
<th>Resting Heart Rate (beats/min)</th>
<th>Stroke Volume (mL/beat)</th>
<th>Cardiac Output (mL/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>70</td>
<td>70</td>
<td>4900</td>
</tr>
<tr>
<td>B</td>
<td>98</td>
<td>50</td>
<td>4900</td>
</tr>
<tr>
<td>C</td>
<td>35</td>
<td>140</td>
<td>4900</td>
</tr>
</tbody>
</table>

- Another indicator of fitness: length of time for heart to return to resting heart rate after strenuous exercise
HOMEWORK

- p.493 #1-7, 9-14