

This is the **Higher Combined** version — includes Higher Tier content. Some Separate-only details are omitted.

During exercise, the body adjusts several physiological processes to meet the increased energy demands of working muscles.

Required Practical: Investigating the effect of exercise on pulse rate and breathing rate — record before, during and after exercise. Repeat at different intensities.

- Heart rate increases: delivers more O₂ and glucose to muscles via blood, and removes CO₂ and lactic acid faster.
 - Breathing rate and depth increase: takes in more O₂ and removes more CO₂.
 - Vasodilation of blood vessels supplying muscles: increases blood flow to working muscles.
 - At low-moderate intensity: aerobic respiration meets energy demands.
 - At high intensity: aerobic respiration cannot supply O₂ fast enough → muscles switch to anaerobic respiration → lactic acid builds up.
 - After exercise: heart rate and breathing rate remain elevated until oxygen debt is repaid and lactic acid is broken down.
- ★ **HT Fitter individuals:** recover faster (return to resting heart rate more quickly), have lower resting heart rate, larger stroke volume (cardiac output same at lower heart rate).

Key Terms

Vasodilation	Widening of blood vessels — increases blood flow to muscles during exercise
Stroke volume	Volume of blood pumped per heartbeat — increases with fitness
Cardiac output	Volume of blood pumped per minute = heart rate × stroke volume

■ **Exam Tip:** When asked to explain why heart rate increases during exercise: 1) muscles use more O₂ for respiration; 2) CO₂ and lactic acid build up; 3) heart rate increases to deliver more O₂ and remove CO₂/lactic acid faster. Give the REASON, not just the observation.