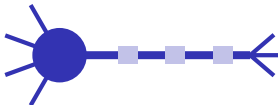


Control & Coordination

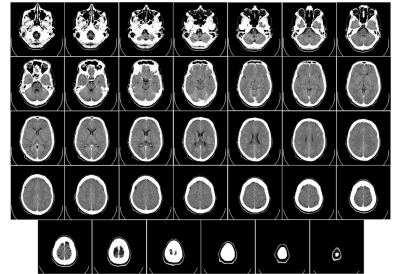
A-Level Biology ■ Topic 15

A-Level Biology



What we will cover

- 1 Two control systems
- 2 Neurones & the reflex arc
- 3 The nerve impulse
- 4 The synapse
- 5 Muscle contraction
- 6 Plant coordination



the brain coordinates it all

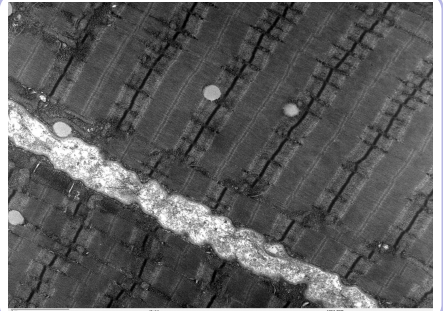
Two control systems

nervous 神经系统

electrical **impulses** 冲动
– fast, short-lived

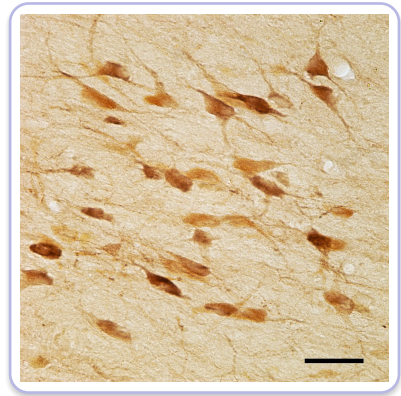
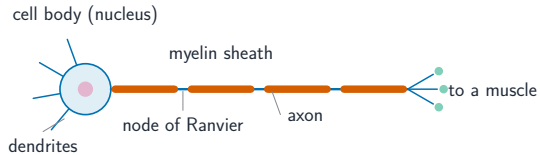
endocrine

chemical **hormones**
in blood –



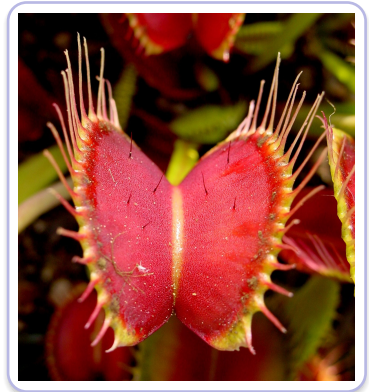
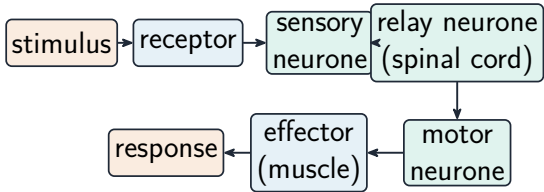
muscle striations tem

Neurones



neuron micrograph

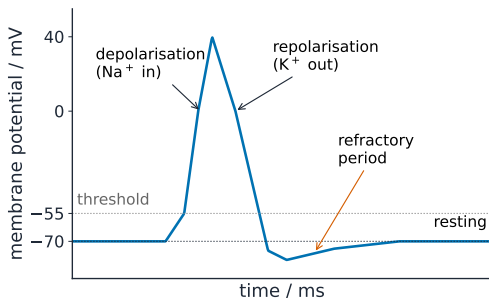
The reflex arc



venus

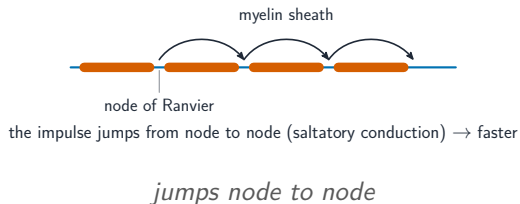
flytrap

The nerve impulse



- **resting potential** 静息电位 – inside negative
- **action potential** 动作电位 – Na^+ in (depolarisation 去极化), then K^+ out (repolarisation 复极化)
- **refractory period** 不应期 – limits the frequency

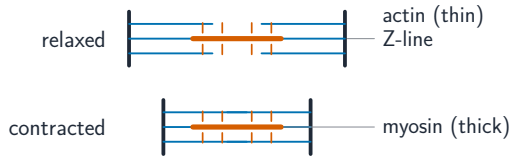
Faster impulses and the synapse



Myelin 髓鞘 makes the impulse jump node to node (**saltatory conduction** 跳跃式传导) – much faster.

At a **synapse** 突触, Ca^{2+} triggers **acetylcholine** 乙酰胆碱 release; it crosses the gap and starts a new impulse.

Muscle contraction

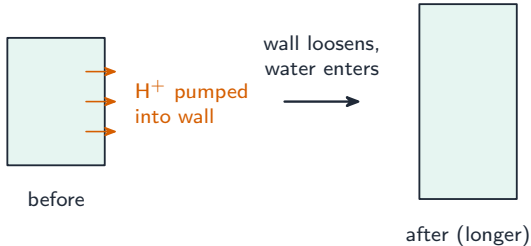


the filaments slide over each other, so the sarcomere shortens

The **sliding filament model** 肌丝滑动模型:

- Ca^{2+} uncovers binding sites on **actin** 肌动蛋白
- **myosin** 肌球蛋白 heads pull it in (using ATP)
- the **sarcomere** 肌节 shortens

Plant coordination



Auxin 生长素 causes “acid growth”: it pumps H⁺ into the wall, loosening it so the cell stretches longer.

Gibberellin 赤霉素 switches on amylase for **germination** 萌发; the Venus fly trap uses fast electrical signals.

Worked example – across the synapse

Explain how an impulse crosses a cholinergic synapse.

- The action potential depolarises the presynaptic membrane, opening **voltage-gated Ca^{2+} channels**.
- Ca^{2+} enters; vesicles fuse and release **acetylcholine** by exocytosis.
- ACh diffuses across and binds receptors, opening **Na^+ channels** $\Rightarrow$ postsynaptic depolarisation.
- **Acetylcholinesterase** breaks ACh down, so the synapse resets $\Rightarrow$ **one-way, brief**.

Vesicles are only on **one** side and receptors only on the other – that is what makes transmission **unidirectional**.

Topic 15 – key takeaways

1

Two systems

nervous fast electrical; endocrine
slow chemical

2

Impulse

Na^+ in depolarises; K^+ out
repolarises

3

Synapse

acetylcholine crosses to start a
new impulse

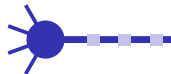
4

Muscle

sliding filaments shorten the
sarcomere

Check yourself

- 1 Which ion rushes in during depolarisation?
- 2 What is myelin's jumping conduction called?
- 3 Which neurotransmitter acts at a cholinergic synapse?
- 4 Which filament slides in muscle contraction?



Answers 1. sodium (Na^+) 2. saltatory conduction 3. acetylcholine 4. actin (thin filament)