IB BIOLOGY | C3.1 | SL AND HL

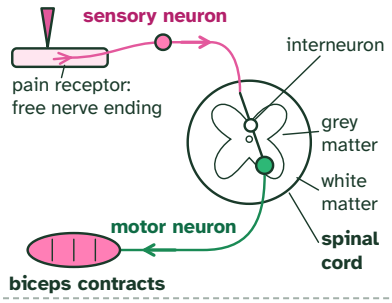
REVISION ON TWO PAGES

How a body works as *one*

What to know, what to draw and what to say. Nothing else.

THE ONE IDEA

Nerves, hormones and blood link an animal's organs, and phytohormones a plant's, so each works as one whole.



Draw it like this. Sensory in, an interneuron in grey matter, motor out.

C3.1.6, 7 and 9 START HERE

The pain *reflex arc*

- **Input: sensory neurons** carry impulses from receptor cells to the CNS: the spinal cord and the cerebral hemispheres.
- **Output: motor neurons** carry impulses from the CNS to muscles, which are **stimulated to contract**. Voluntary movements start in the cerebral hemispheres.
- **Pain reflex:** a free nerve ending in the hand (receptor), sensory neuron, **one interneuron in the grey matter**, motor neuron, biceps (effector).
- It is **involuntary** and completed in the spinal cord, so the hand moves **before** the brain is aware. The effector is a **skeletal muscle**.

C3.1.1 and 2

Many parts, *one animal*

- **Integration**: coordinating a system's parts so they perform an **overall function**.
- **Hierarchy:** cells, tissues, organs, body systems: each a **subsystem** of the next.
- **Emergent property**: one the whole has and none of its parts has.

Cheetah parts
Long legs, flexible spine, big heart and lungs.

Cheetah whole emergent
Top land speed: an **effective predator**.

C3.1.3

Nerves, hormones and *blood*

	NERVOUS	ENDOCRINE
Signal	Impulses along neurons	Hormones from glands, in the blood
Speed	A fraction of a second	Seconds to minutes
Reaches	One muscle or gland	Only cells with its **receptor** respond
Lasts	Usually a moment	Often minutes to days

- **Blood transports materials and energy**: oxygen from lungs to muscles, glucose to the brain, urea to the kidneys, heat to the skin.

C3.1.4 and 10

The brain *integrates*

- **Cerebral hemispheres:** combine inputs from several senses, compare them with memory and **choose a response**.
- They **learn and remember**; each kind of memory depends on its own regions.
- **Cerebellum: coordinates skeletal muscle contraction** and **balance**, but does not start movements.

C3.1.5

Conscious or not

- The spinal cord is an **integrating centre for unconscious processes**, in its grey matter.

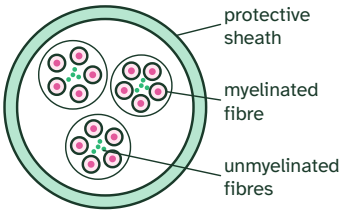
Conscious aware, in control
Speaking: the cerebral hemispheres.

Unconscious no awareness
A reflex, the heartbeat.

C3.1.8

Inside a *nerve*

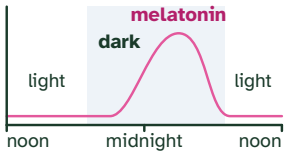
- A nerve is a **bundle of nerve fibres**: the axons of many neurons.
- Most carry **sensory and motor** fibres.



C3.1.11

Melatonin and sleep

- A **circadian rhythm**: a cycle of about 24 hours, kept by a clock in the hypothalamus.
- The **pineal gland** secretes melatonin, **low by day, high at night**, as light on the eyes switches it off. It makes you sleepy: a cycle of sleeping and waking.



C3.1.12

Epinephrine: ready to run

- In danger the **adrenal glands** secrete epinephrine (adrenaline); the blood takes it all over the body.
- A faster, stronger heartbeat; wider airways; glucose from the liver; blood sent to the muscles.
- So **more oxygen and glucose reach the muscles** for **intense contraction**.

Feedback, the gut, and how *plants* signal

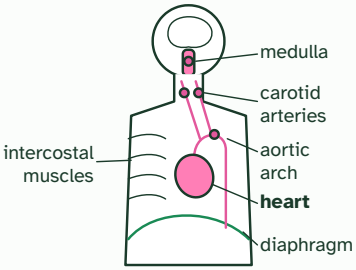
C3.1.14 and 15 THE RESPONSE REVERSES THE CHANGE

Feedback sets heart rate and *breathing*

	HEART RATE *C3.1.14*	VENTILATION RATE *C3.1.15*
Receptors	**Baroreceptors** (aortic arch, carotid arteries) sense stretch: **blood pressure**. **Chemoreceptors** there and in the brainstem: pH, O_2, CO_2.	**Chemoreceptors in the brainstem** monitor **blood pH**. CO_2 forms carbonic acid, releasing H^+: **more CO_2, lower pH**.
Control	The **medulla** sends impulses to the heart.	The **medulla** sends impulses more often.
Response	**Heart rate and stroke volume** change, reversing it.	**Diaphragm and intercostals** work harder: CO_2 out, pH back.

Receptor, control centre, effector: *Rabbits Can Escape*

Both are negative feedback



Pink dots: receptor sites. Arteries: baroreceptors and chemoreceptors. Medulla: chemoreceptors

C3.1.13

The *hypothalamus* in charge

- The hypothalamus **controls the pituitary gland**, whose hormones **control other endocrine glands**.
- **Thyroid:** its hormone raises metabolism; as it rises, both secrete less: **negative feedback**.

C3.1.16

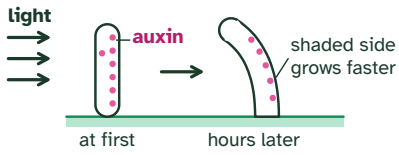
Peristalsis: who is in charge

- Muscle **contracts behind** the food and relaxes in front.
- **Voluntary (CNS):** starting to **swallow**; **egestion** of faeces.
- **Involuntary, between:** the **enteric nervous system** coordinates passage.

C3.1.17 and 18 HIGHER LEVEL

Growing towards *light*

- **Positive phototropism**: growth towards light from one side.
- Drawings are **qualitative**; the **angle of curvature** is quantitative. Photos square-on: accurate. Repeats: reliable.



C3.1.19 to 21 HIGHER LEVEL

Auxin on the move

- **Phytohormones**: **varied** chemical signals for growth, development and responses.
- Auxin diffuses in, not out. **Efflux carriers** on one side **actively transport** it on, concentrating it.
- It makes cells **secrete H^+ into the apoplast**; acid **loosens cellulose cross links**, so cells elongate.

C3.1.22 and 23 HIGHER LEVEL

Roots, shoots, *ripening*

- Shoot tips send **auxin** down (side roots form); root tips send **cytokinin** up (shoot cells divide): **growth is integrated**.
- **Ethylene stimulates ripening**, and ripening makes more ethylene: **positive feedback**.
- So fruit ripen **rapidly and together**, ready for animals that spread seeds.

WATCH OUT

Six mistakes that *cost marks*

- ✕ **A reflex is completed in the spinal cord.** The brain is told afterwards; nothing is decided.
- ✕ **Baroreceptors sense stretch, so pressure.** pH, oxygen and CO_2 are for chemoreceptors.
- ✕ **CO_2, through pH, normally drives breathing.** Low oxygen matters only when it falls far.
- ✕ **A nerve is not a neuron.** It is a bundle of fibres from many neurons.
- ✕ **Light lowers melatonin.** Darkness lets it rise.
- ✕ **The lit side still grows.** The shaded side grows more; nothing pulls the shoot.

COVER THE SHEET

Can you *answer these?*

1. Outline an emergent property, using the cheetah.
2. Distinguish nervous from hormonal signalling.
3. Compare the roles of the cerebrum, cerebellum and spinal cord.
4. Draw a pain reflex arc, and a nerve in transverse section.
5. Explain how melatonin sets a cycle of sleep and waking.
6. Explain how epinephrine prepares the body to run.
7. Outline how the hypothalamus controls the thyroid.
8. Explain how exercise raises heart and ventilation rates.
9. State what controls each stage of moving food along the gut.
10. Explain how auxin bends a shoot, and how to measure it. HL
11. Explain why fruit ripening is rapid and synchronised. HL

IN THE EXAM

Name every part of the loop: the receptor and where it is, the **medulla**, the effector, and that the change is **reversed**.

GO FURTHER

Animated figures, a dry lab and a marked Check are in the full guide online.