Hormones, stress and behavioural regulation

Supported GRE teaching and original transfer practice

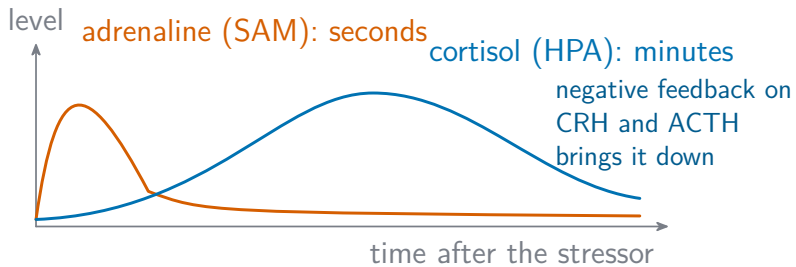
Hormones, stress and behavioural regulation

- Compare the fast sympathetic path with the slower **HPA axis** - -
  .
- Explain **negative feedback** .
- Match major hormones to the systems they regulate.
- Compare hormonal and neural signalling, including the role of **receptors** .

Two stress clocks

- Fast: the sympathetic nervous system signals the adrenal medulla to release adrenaline (epinephrine) within seconds. Heart rate, breathing and blood glucose rise.
- Slow: the hypothalamus releases CRH, the pituitary releases ACTH, and the adrenal cortex releases **cortisol** . Cortisol peaks after about 20–30 minutes.
- Cortisol makes energy available and reduces non-urgent activity such as digestion and some immune responses.

Figure: Two stress clocks

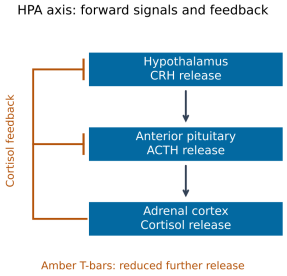


- A fast and a slow stress clock.
- Read the axes and units first.

Negative feedback

- This is **negative feedback**: the output of a system turns the system down, so the response ends when the stressor passes.
- Problems arise when stress is repeated or never ends, or when feedback is weakened. The hormone itself is adaptive.
- Selye's three stages: alarm (the first response), resistance (continued coping) and exhaustion (resources run down under long stress).

Figure: Negative feedback



- Cortisol's **negative feedback** on the hypothalamus and pituitary limits the stress response
- Read the axes and units first.

Hormones and their jobs

- Insulin lowers blood glucose; glucagon raises it. They work in opposition.
- Melatonin, from the pineal gland, rises in darkness and helps time sleep.
- Oxytocin causes contractions in labour and the release of milk, and is linked to social bonding.

Hormones and their jobs (2)

- Progesterone prepares and maintains the lining of the uterus for pregnancy.
- Thyroid hormones set the body's general rate of metabolism.

Hormones and nerves

- Neural signals are usually fast, brief and sent to specific targets.
- Hormones travel in the blood, so they reach the whole body and usually act more slowly and for longer.
- A hormone affects only cells that carry its receptor. That is how a signal sent everywhere can still have selective effects.
- These are tendencies, not rules: noradrenaline works both as a hormone and as a neurotransmitter.

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Worked example: a near-miss

- Within seconds: adrenaline from the adrenal medulla. The heart pounds and the hands shake.
- Over the next half hour: CRH, then ACTH, then cortisol rises.
- As cortisol rises, it inhibits CRH and ACTH, and the levels fall back during the next hours.

Worked example: matching hormones

- A student's blood glucose rises after lunch, then returns to normal: insulin.
- A traveller crossing time zones takes a supplement to shift sleep time: melatonin.
- A mother's milk flows when her baby cries: oxytocin.

Common errors

- Giving the HPA order wrongly; it is CRH, then ACTH, then cortisol.
- Calling cortisol harmful in itself; chronic activation and failed regulation cause harm.
- Linking each hormone to one emotion.

Common errors (2)

- Forgetting **receptors** when explaining selective effects.
- Treating "nerves are fast, hormones are slow" as an absolute rule.

Key terms

- **HPA axis**: The hypothalamus–pituitary–adrenal chain that produces the slower cortisol stress response.
- **cortisol**: The main stress hormone of the adrenal cortex, which makes energy available.
- **negative feedback**: Regulation in which a system's output reduces further output.
- **receptors**: Proteins on or in cells that bind a specific signalling molecule.

Check yourself

- Which gland releases ACTH?
- Which stress hormone rises first after a sudden fright?
- How can a hormone in the whole bloodstream affect only some organs?