

Biological Bases of Behavior

AP Psychology ■ Unit 1

AP Psychology



What we will cover

- 1 Nature and Nurture
- 2 The Nervous System
- 3 Neurons and How They Fire
- 4 Neurotransmitters, Hormones, and Drugs
- 5 The Brain
- 6 Consciousness and Sleep



Nature and Nurture

Psychology studies **behavior** (what a person does) and **mental processes** (what a person thinks and feels). Unit 1 asks where these come from in the body.

- **Nature and nurture** always interact. Height is inherited, but poor nutrition lowers it.
- The **evolutionary perspective** explains behavior that helped ancestors survive and reproduce. Fear of snakes is easy to learn because it once kept people alive.
- **Twin and adoption studies** separate the two sources. If identical twins raised apart are still similar, heredity matters for that trait.

Nature and Nurture, continued

Every trait grows from two sources working together. **Heredity** is what a person inherits from their parents. **Environment** is everything that happens around them. Neither one acts alone.



The Nervous System

The **nervous system** carries information around the body. It has two main parts.

- The **somatic nervous system** controls **voluntary** movement, such as raising your hand.
- The **autonomic nervous system** controls **involuntary** processes, such as heartbeat and digestion. It has two branches that work against each other: the **sympathetic nervous system** prepares the body for action (the "fight or flight" response), and the **parasympathetic nervous system** calms the body down afterwards.

Voluntary or automatic, then arousing or calming

- The **somatic nervous system** controls **voluntary** movement, such as raising your hand.
- The **autonomic nervous system** controls **involuntary** processes, such as heartbeat and digestion.

The divisions of the nervous system

Central nervous system

The **central nervous system (CNS)**: brain and spinal cord – where information is integrated and decisions are made.

Peripheral nervous system

The **peripheral nervous system (PNS)**: everything else, split into somatic (voluntary) and autonomic (automatic).

The three neuron types

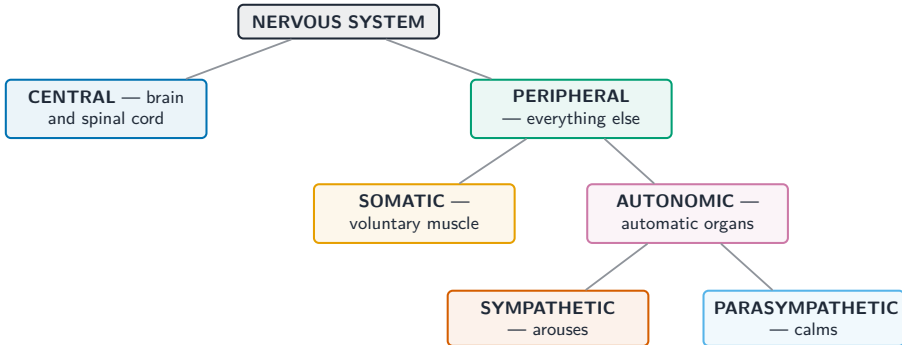
Sensory neurons carry in, **motor neurons** carry out, and **interneurons** connect them inside the CNS.

The reflex arc

A **reflex arc** routes sensory to motor through the spinal cord, so the response happens before the brain is involved.

Name the division *and* the direction. Half the marks in this unit are in getting sensory and motor the right way round.

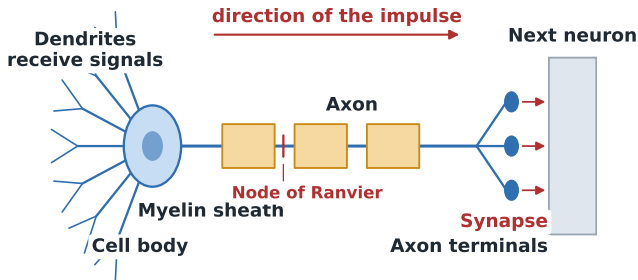
Voluntary or automatic, then arousing or calming, in detail



The **autonomic nervous system** controls **involuntary** processes, such as heart-beat and digestion.



Dendrites receive, the axon carries, the synapse passes it on



- At rest the neuron holds a **resting potential**, ready but not firing.
- If incoming signals pass the **threshold**, the neuron **depolarizes** and fires.
- Firing follows the **all-or-none principle**: the neuron fires at full strength or not at all.
- Straight after firing there is a **refractory period** when the neuron cannot fire

Neurons and How They Fire

Two kinds of cell do the work. **Neurons** transmit information. **Glial cells** provide structure, insulation, communication, and waste transport. Together they are the building blocks of all behavior and mental processes.

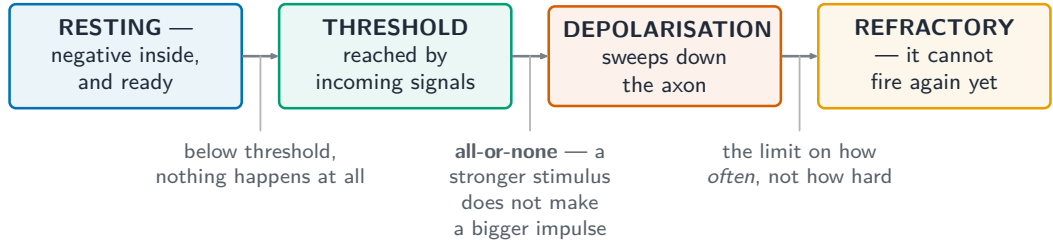
- At rest the neuron holds a **resting potential** , ready but not firing.
- If incoming signals pass the **threshold** , the neuron **depolarizes** and fires.
- Firing follows the **all-or-none principle** : the neuron fires at full strength or not at all. A stronger stimulus makes it fire more often, not harder.
- Straight after firing there is a **refractory period** when the neuron cannot fire again.
- At the **synapse** , the gap between neurons, chemicals cross to the next cell. Leftover chemicals are taken back in a process called **reuptake** .

Neurons and How They Fire, continued

A neuron has **dendrites** that receive signals, a **cell body** , and an **axon** that carries the signal away. Many axons are wrapped in a **myelin sheath** , which speeds the signal up.

Damage to this process can cause disorders such as **multiple sclerosis** or **myasthenia gravis** .

How a neuron fires



Intensity is coded by **how often** a neuron fires and how many fire – never by how strongly a single impulse travels



Neurotransmitters, Hormones, and Drugs

- An **agonist** encourages neural firing.
- An **antagonist** discourages it.
- A **reuptake inhibitor** blocks reabsorption, leaving more transmitter in the synapse.

Chemicals, drugs and pain

Endorphins

Endorphins are the body's own opioids: they dampen pain and are released by exercise, injury and stress.

Psychoactive drugs

Psychoactive drugs work by mimicking a transmitter (agonists) or blocking it (antagonists) – which is why their side effects follow the transmitter's other jobs.

Gate control theory

Gate control theory: the spinal cord has a “gate” that other input can close – rubbing a knock really does reduce the pain.

Phantom limb

Phantom limb sensation shows the same point from the other side: the brain can generate pain with no input at all.

Pain is constructed, not transmitted. Both the gate and the phantom limb are evidence for that one claim.

Hormones, and the three ways a drug acts

hormones

act outside the nervous system, travelling more slowly through the **blood**

agonists

mimic or boost a neurotransmitter's effect

antagonists

block the receptor so the transmitter cannot act

reuptake inhibitors

stop the transmitter being reabsorbed, so it stays in the **synapse** longer
– how SSRIs work

Five hormones are examinable: **adrenaline** , **leptin** , **ghrelin** , **melatonin** , **oxytocin** . And every **psychoactive drug** on the syllabus is one of those three mechanisms – naming it, not just the drug, is what earns the mark.

The six examinable neurotransmitters

dopamine

reward and movement

serotonin

mood and sleep

norepinephrine

alertness and arousal

glutamate

the main **excitatory** transmitter – learning and memory

GABA γ -

the main **inhibitory** transmitter – calming

acetylcholine

muscle movement and memory

Only these six are examinable. Learn each one's **one-line job** – that is the level the multiple-choice questions test at.

Neurotransmitters, Hormones, and Drugs, continued

Drug categories: **stimulants** (caffeine, cocaine) increase neural activity; **depressants** (alcohol) decrease it; **hallucinogens** (marijuana) distort perception; **opioids** (heroin) relieve pain.

Repeated use can lead to **tolerance**, where more is needed for the same effect, and to **addiction**, with **withdrawal** symptoms when use stops.



The Brain

The brain is studied from the bottom up, because the lower structures handle the most basic jobs.

- The **brain stem** , including the **medulla** , controls breathing and heart rate.
- The **reticular activating system** controls alertness and arousal.
- The **cerebellum** controls coordination, balance, and some **procedural learning** .
- The **limbic system** sits inside the cerebral cortex and includes the **thalamus** (a relay station for the senses), the **hypothalamus** (hunger, thirst, temperature), the **pituitary gland** , the **hippocampus** (forming new memories), and the **amygdala** (fear and emotion).

The Brain, continued

The **cerebral cortex** is divided into two **hemispheres** and four lobes: the **occipital lobes** process vision at the rear; the **temporal lobes** process hearing and language at the sides; the **parietal lobes** hold the **somatosensory cortex** for touch; and the **frontal lobes** handle higher-order thinking and **executive function**.

Language sits mainly in the left hemisphere: **Broca's area** for speech production and **Wernicke's area** for comprehension.

Studying the brain, and what sleep does

Lesioning

Lesioning destroys tissue deliberately in animal studies; in humans, natural damage plays the same role – and **prosopagnosia**, the inability to recognise faces, is one such case.

REM and NREM

NREM sleep deepens through three stages; **REM sleep** brings vivid dreams with the body paralysed – and **REM sleep behavior disorder** is that paralysis failing.

Why we sleep

Restoration repairs the body, and **memory consolidation** moves the day's learning into long-term storage.

Dream theories

Activation-synthesis theory says the cortex weaves a story from random brain-stem activity; **hypnagogic sensations** are the falling jolts at sleep onset.

Each dream theory makes a different prediction about *content*. That is how they can be told apart.

Split-brain research, plasticity, and how the brain is studied

split-brain research

patients whose **corpus callosum** was cut to treat severe epilepsy – the two hemispheres then work **independently**

what it showed

language is usually **left**-lateralised: an object shown only to the right hemisphere can be picked up but not named

brain plasticity

the brain rewires and forms new connections, which supports **recovery after damage**

research methods

EEG for electrical activity over time, **fMRI** for which regions are active, and lesion studies

Plasticity is why the same injury has different outcomes in a child and an adult – a favourite comparison question.

Brain regions, by their deficit

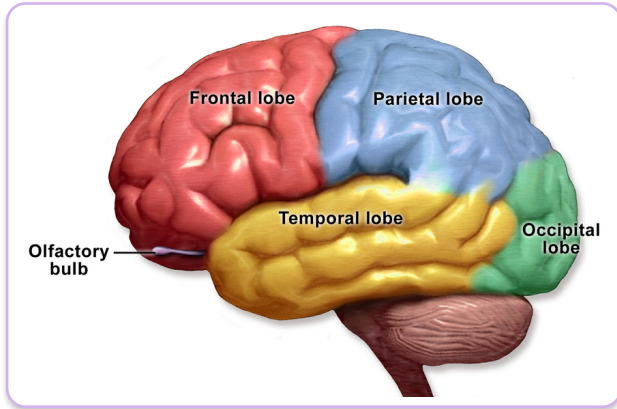
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Brain regions, by their deficit, in detail

REGION	WHAT IT DOES	DAMAGE LOOKS LIKE
brainstem and medulla	breathing, heart rate, arousal	life-threatening — these are not optional
cerebellum	balance, and smooth learned movement	clumsy, uncoordinated movement
hippocampus	forming new long-term memories	old memories intact, no new ones
amygdala	fear, and emotional salience	blunted fear, poor threat learning
frontal lobe	planning, judgement, inhibition	impulsivity and personality change

The **reticular activating system** controls alertness and arousal.

The four lobes of the cortex



- **occipital lobes** – vision, at the rear
- **temporal lobes** – hearing and language, at the sides
- **parietal lobes** – **somatosensory cortex** for touch
- **frontal lobes** – higher-order thinking and **executive function**



Consciousness and Sleep

The sleep/wake cycle is a **circadian rhythm** of about 24 hours. **Jet lag** and shift work disrupt it.

REM sleep is called **paradoxical sleep** because the brain looks awake while the body is most relaxed, and most dreaming happens here.



measuring sleep, in practice

Dreams and sleep disorders

consciousness

awareness of internal and external events – it varies in **level**, not just presence

activation–synthesis –

the brain **interprets random activity** generated during REM sleep

consolidation theory

dreaming is a by-product of **transferring memories** into long-term storage

not examinable

the psychoanalytic theory of dreams is outside the exam's scope

the disorders

insomnia , **narcolepsy** , **sleep apnea** , **somnambulism** and REM sleep behaviour disorder

Both examinable dream theories are **biological**. Neither says a dream means anything – which is precisely the distractor the exam offers.



Sensation

The **just-noticeable difference** is the smallest change a person can detect.

Sensory adaptation

is reduced sensitivity to an unchanging stimulus – you stop noticing a smell.

Sensory interaction

means the senses work together. **Synesthesia** is when one sense triggers another.

The other senses, and the thresholds

olfaction

smell – the **only** sense not relayed first through the thalamus, which is why odours reach memory and emotion so directly

gustation

sweet, sour, salty, bitter and **umami**

touch and pain

skin receptors transduce touch; “hot” comes from warm *and* cold receptors firing together. Pain is processed in body **and** brain, which is why expectation changes it

absolute threshold

the weakest stimulus detected **half** the time

difference threshold

the smallest change that can be noticed – a **proportion** of the original, by Weber's law

Sensory adaptation means constant stimuli fade from awareness. You stop feeling your watch within minutes of putting it on.

Vision and hearing, in the terms the exam uses

visual accommodation

the **lens** changes shape to focus light on the **retina**

when it fails

nearsighted focuses in front of the retina, **farsighted** behind it

place theory

pitch from **which part** of the cochlea vibrates – explains **high** frequencies

frequency theory

pitch from **how fast** the whole membrane fires – explains **low** frequencies

deafness

conduction deafness damages the mechanism; **sensorineural** damages the hair cells or nerve

Sound is air movement: **wavelength gives pitch**, **amplitude gives loudness**. Two theories are needed because neither covers the whole range alone.

The senses, receptor by receptor

Rods and cones

Rods see in dim light with no colour; **cones** need light and give colour and detail, packed most densely at the **fovea**.

Focus and hearing

Nearsightedness focuses the image in front of the retina, **farsightedness** behind it. **Sensorineural deafness** is damage to the hair cells or the auditory nerve.

Colour and afterimages

Opponent-process theory explains **afterimages**: cells signal red-or-green, so fatiguing one leaves the other.

The other senses

Kinesthesia senses limb position; the **semicircular canals** sense balance; **oleogustus** is the taste of fat; **sound localization** compares the two ears' timing and intensity.

Trichromatic theory works at the receptor, opponent-process after it. Both are right, at different stages.

Worked example – how far do the findings generalize?

2025 Article Analysis: *“Explain the extent to which the research findings may or may not be generalizable, using specific and relevant evidence from the study.”*

- **Full marks:** *“The findings may not generalize widely because the participants were undergraduates at a single university, so the sample does not represent the age range or the range of backgrounds in the population the claim is about.”*
- Name the limitation **and** tie it to evidence in the study.

“The sample was biased” names nothing. Say *which* feature of the sample, and *which* population it fails to represent.

Exam tips

- Learn only the listed **neurotransmitters** and **hormones**; the exam will not ask about others, and the endocrine glands are out of scope apart from the pituitary.
- Keep **sensation** separate from perception: sensation is detecting and transducing, perception is interpreting (Unit 2).
- The **all-or-none principle** means intensity is coded by how *often* a neuron fires, never by how strongly.
- Match structure to job before you write: hippocampus forms memories, amygdala handles fear, cerebellum coordinates movement.
- **Sympathetic** arouses, **parasympathetic** calms. If a question describes a racing heart, name the sympathetic branch.
- Say what a scan can and cannot show. **fMRI** shows activity over time; **EEG** shows electrical patterns and identifies sleep stages.



Unit 1 – key takeaways

1

Neurons

all-or-none; intensity is firing *rate*

2

Autonomic

sympathetic arouses;
parasympathetic calms

3

Brain

hippocampus memories; amygdala
fear; cerebellum movement

4

Senses

sensation detects; perception
interprets (Unit 2)

Check yourself

- 1 How is stimulus intensity coded in a neuron?
- 2 A racing heart: which autonomic branch?
- 3 What does the hippocampus do?
- 4 What can fMRI show that EEG cannot?

Answers: firing rate (not strength) ▪ sympathetic ▪ forming new memories ▪ activity over time / localisation