

An anatomical illustration of the human nervous system, showing the brain, spinal cord, and peripheral nerves in a translucent blue body. The brain is highlighted in orange and yellow, with a network of nerves extending down the spine and branching out to the limbs.

Neuroanatomy and Neuroscience at a Glance

Fifth Edition

**Roger A. Barker
Francesca Cicchetti
Emma S. J. Robinson**



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Neuroanatomy and Neuroscience

at a Glance

Fifth Edition

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*This book is dedicated to Imogen Rose Barker,
who died tragically in February 2007: a wonderful
daughter and an inspiration to many.*

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Introduction



Neuroanatomy and Neuroscience at a Glance is designed primarily for medical students as a revision text or review of basic neuroscience mechanisms, rather than a comprehensive account of the field of medical neuroscience. The book does not attempt to provide a systematic review of clinical neurology, although one of the new features of the fourth edition was the introduction of more clinical cases to illustrate how neurology builds on a good knowledge of basic neuroscience. In addition, the changing nature of medical training has meant that rather than teaching being discipline-based (anatomy, physiology, pharmacology, etc.), the current approach is much more integrated with the focus on the entire system. Students pursuing a problem-based learning course will also benefit from the concise presentation of integrated material.

This book summarizes the rapidly expanding field of neuroscience with reference to clinical disorders, such that the material is set in a clinical context with the later chapters being more clinically oriented. However, learning about the organization of the nervous system purely from clinical disorders is short-sighted as the changing nature of medical neuroscience means that areas with little clinical relevance today may become more of an issue in the future. An example of this is ion channels and the recent burgeoning of a host of neurological disorders secondary to a channelopathy. For this reason, some chapters focus more on scientific mechanisms with less clinical emphasis.

Each chapter presents the bulk of its information in the form of an annotated figure, which is expanded in the accompanying text. It is recommended that the figure is worked through with the text rather than just viewed in isolation. The condensed nature of each chapter means that much of the information has to be given in a didactic fashion. Although the text focuses on core material, some additional important details are also included.

The book is structured such that it begins with the anatomical and functional organization of the nervous system

(Chapters 1–11); the cells of the nervous system and how they work (Chapters 12–21); the sensory components of the nervous system (Chapters 22–34); the motor components of the nervous system (Chapters 35–42); the autonomic, limbic and brainstem systems underlying wakefulness and sleep along with neural plasticity and a new chapter on techniques to study the nervous system in the lab (Chapters 43–49); and, finally, a section on the approach, investigation and range of clinical disorders of the nervous system (Chapters 50–65).

Each section builds on the previous ones to some extent, and so reading the introductory chapter may give a greater understanding to later chapters in that section; for example, the somatosensory system chapter (Chapter 31) may be better read after the chapter on the general organization of sensory systems (Chapter 22).

In this latest edition of the book we have attempted to further integrate the clinical relevance of neurobiology into the text and website and brought in a new author to help with the neuropharmacological developments in central nervous system disease, Dr Emma Robinson. We have continued and updated our ‘Did you know?’ section at the end of each chapter while Part 7 consists of relevant clinical scenarios for each chapter along with questions and answers. The companion website has key revision points and multiple-choice questions relating to the content of each chapter.

We hope that you find this new edition of the book a useful accompaniment to your studies from undergraduate to postgraduate to clinical level.

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List of abbreviations



ACA	anterior cerebral artery	DAG	diacylglycerol
ACE-r	Addenbrooke's Cognitive Examination, revized	DAT	dementia of the Alzheimer type
ACh	acetylcholine	DAT	dopamine transporter (scan)
AChE	acetylcholinesterase	dB	decibel
AChR	acetylcholine receptor	DC	dorsal column
ACTH	adenocorticotrophic hormone	DCN	dorsal cochlear nucleus
ADH	antidiuretic hormone (vasopressin)	DoCN	dorsal column nuclei
ADHD	attention deficit hyperactivity disorder	DCNN	deep cerebellar nuclei neurone
ALS	amyotrophic lateral sclerosis	DMD	Duchenne's muscular dystrophy
ANS	autonomic nervous system	DNA	deoxyribonucleic acid
APP	amyloid precursor protein	DREADD	Designer Receptors Exclusively Activated by Designer Drugs
ATP	adenosine triphosphate	DRG	dorsal root ganglion
AVM	arteriovenous malformation	DSCT	dorsal spinocerebellar tract
BBB	blood–brain barrier	DSIP	delta sleep-inducing peptide
BDNF	brain derived neurotrophic factor	DSM-V	Diagnostic and Statistical Manual of Mental Disorders, 5th edition
BM	basilar membrane	ECG	electrocardiography/electrocardiogram
BMP	bone morphogenic protein	ECT	electroconvulsive therapy
BPPV	benign paroxysmal positional vertigo	EEG	electroencephalography/ electroencephalogram
BSAEP	brainstem auditory-evoked potential	EMG	electromyography/electromyogram
CAA	cerebral amyloid angiopathy	ENS	enteric nervous system
CADASIL	cerebral autosomal-dominant arteriopathy with subcortical infarcts and leucoencephalopathy	EP	evoked potential
cAMP	cyclic adenosine monophosphate	epp	end-plate potential
CBM	cerebellum	EPSP	excitatory postsynaptic potential
CCK	cholecystokinin	FDG	[¹⁸ F]2-fluoro-2-deoxy-D-glucose
cf	climbing fibre	FEF	frontal eye field(s)
cGMP	cyclic guanosine monophosphate	fMRI	functional magnetic resonance imaging
CMCT	central motor conduction time	FTD	fronto-temporal dementia
CMUA	continuous motor unit activity	GABA	γ-aminobutyric acid
CNF	cuneiform nucleus	GAD	glutamic acid decarboxylase
CNS	central nervous system	GDNF	glial cell line derived neurotrophic factor
CNTF	ciliary neurotrophic factor	GoC	Golgi cell
COMT	catecholamine- <i>O</i> -methyltransferase	GPe	globus pallidus, external segment
CoST	corticospinal tract	GPI	globus pallidus, internal segment
COX	cyclo-oxygenase	G-protein	guanosine triphosphate-binding protein
CPAP	continuous positive airway pressure	GrC	granule cell
CPG	central pattern generator	GTO	Golgi tendon organ
CPK	creatine phosphokinase	GWAS	genome-wide association study
CRH	corticotrophin-releasing hormone	HIV	human immunodeficiency virus
CRPS	complex regional pain syndrome	HLA	histocompatibility locus antigen
CSF	cerebrospinal fluid	HMM	heavy meromyosin
CT	computed tomography	HMSN	hereditary motor sensory neuropathy
CVA	cerebrovascular accident		
DA	dopamine		

HPA	hypothalamic–pituitary–adrenal	OCD	obsessive compulsive disorder
HPLC	high-performance liquid chromatography	OD	ocular dominance
5-HT	5-hydroxytryptamine (serotonin)	OHC	outer hair cell
HTM	high-threshold mechanoreceptor	OSA	obstructive sleep apnoea
Hz	hertz	PCA	posterior cerebral artery
IC	inferior colliculus	PCR	polymerase chain reaction
ICA	internal carotid artery	PET	positron emission tomography
IHC	inner hair cell	pf	parallel fibre
ILN	intralaminar nuclei (of the thalamus)	PG	prostaglandin
IN	interneurone	PICA	posterior inferior cerebellar artery
IP₃	inositol triphosphate	PMC	premotor cortex
IPAN	intrinsic primary afferent neurones	PMN	polymodal nociceptors
iPS	induced pluripotent stem cell	PMP	peripheral myelin protein
IPSP	inhibitory postsynaptic potential	PNS	peripheral nervous system
JPS	joint position sense	PPC	posterior parietal cortex
LC	locus coeruleus	PPN	pedunculo pontine nucleus
LEMS	Lambert–Eaton myasthenic syndrome	PPRF	paramedian pontine reticular formation
LGMD	limb girdle muscular dystrophy	PuC	Purkinje cell
LGN	lateral geniculate nucleus of the thalamus	RA	rapidly adapting receptor
LMM	light meromyosin	REM	rapid eye movement
LMN	lower motor neurone	ReST	reticulospinal tract
LTD	long-term depression	riMLF	rostral interstitial nucleus of the medial longitudinal fasciculus
LTP	long-term potentiation	RMS	rostral migratory stream
MAO	monoamine oxidase	RuST	rubrospinal tract
MAO_A	monoamine oxidase type A	SA	slowly adapting receptor
MAO_B	monoamine oxidase type B	SCA	spinocerebellar ataxia
MAOI	monoamine oxidase inhibitor	SCT	spinocerebellar tract
MCA	middle cerebral artery	SHH	sonic hedgehog
mepp	miniature end-plate potential	SLE	systemic lupus erythematosus
MGN	medial geniculate nucleus of the thalamus	SMA	supplementary motor area
MHC	major histocompatibility complex	Sml	primary somatosensory cortex
MLF	medial longitudinal fasciculus	SmlI	second somatosensory area
MMSE	Mini Mental State Examination	SNAP	soluble NSF attachment protein
MN	motor neurone	SNARE	SNAP receptor
MND	motor neurone disease	SNC	substantia nigra pars compacta
MRA	magnetic resonance angiography	SNP	senile neuritic plaque
MRC	Medical Research Council	SNr	substantia nigra pars reticulata
MRI	magnetic resonance imaging	SNS	sympathetic nervous system
MRV	magnetic resonance venography	SOC	superior olivary complex
Msl	primary motor cortex	SP	substance P
MUSK	muscle-specific kinase	SPECT	single photon emission computed tomography
NA	noradrenaline (norepinephrine)	SR	sarcoplasmic reticulum
nAChR	nicotinic acetylcholine receptor	SSRI	selective serotonin re-uptake inhibitor
NCS	nerve conduction studies	STN	subthalamic nucleus
NFT	neurofibrillary tangle	STT	spinothalamic tract
NGF	nerve growth factor	SUDEP	sudden unexpected death
NMDA	<i>N</i> -methyl- <i>D</i> -aspartate	SVZ	subventricular zone
NMDA-R	<i>N</i> -methyl- <i>D</i> -aspartate glutamate receptor	SWS	slow-wave sleep
NMJ	neuromuscular junction	T	Tesla
NO	nitric oxide	tDCS	transcranial direct-current stimulation
NS	neostriatum	TENS	transcutaneous nerve stimulation
NSAID	non-steroidal anti-inflammatory drug	TIA	transient ischaemic attack
NSF	<i>N</i> -ethylmaleimide sensitive fusion protein	TM	tectorial membrane
OB	olfactory bulb	TMS	transcranial magnetic stimulation
		TNF	tumour necrosis factor
		TRH	thyrotrophin-releasing hormone

T-tubule	transverse tubule	VLPA	ventrolateral preoptic area
UMN	upper motor neurone	VOR	vestibulo-ocular reflex
UPR	unfolded protein response	VP	ventroposterior nucleus of the thalamus
UPS	ubiquitin–proteasome system	VPL	ventroposterior nucleus of the thalamus, lateral part
V1	primary visual cortex (Brodmann's area 17)	VPM	ventroposterior nucleus of the thalamus, medial part
VA–VL	ventroanterior–ventrolateral nuclei of the thalamus	VPT	vibration perception threshold
VCN	ventral cochlear nucleus	VSCT	ventral spinocerebellar tract
VEP	visual-evoked potential	VTa	ventral tegmental area
VeST	vestibulospinal tract	VZ	ventricular zone

Companion website



This book has an accompanying website at:



www.ataglanceseries.com/neuroscience

Features:

- Interactive multiple choice questions for each chapter
- Self-assessment case studies from the book and extra online case studies
- Chapter key points for revision
- Flashcards of key figures with interactive on/off labels
- Figures from the book in PowerPoint format
- Neuroscience and medical glossaries





Anatomical and functional organization

Part 1

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