

Chapter 3 The Biological Bases of Human Behaviour



Overview of Chapter 3

- Cells of the nervous system
- How neural signals are produced and transmitted
- Research methods used re: the brain
- Areas of the brain and their functions
- Impact of genetics and environment

Cells of the Nervous System



- Neurons are responsible for communication
- They transmit, receive, and integrate information
- Glia = support cells
- They nourish, protect, and support neurons



Gord Downie,
The Tragically Hip

Neurons

- 3 main parts
- Cell body or soma
- Dendrites – branching region
- Axon – ‘root’

Detailed description: The top diagram shows a neuron with a central soma, several branching dendrites, and a long axon extending downwards. Labels point to each part. The bottom diagram is a cross-section of a neuron, showing the soma with a nucleus, multiple branching dendrites, a central axon, and a myelin sheath wrapped around the axon. At the end of the axon, there are several small, rounded structures labeled 'Terminal buttons and synapses'.

Neuron and Neural Impulse

Detailed description: This diagram shows a cross-section of an axon with a thick, white myelin sheath. An arrow points along the axon, indicating the direction of signal transmission. Labels include 'Dendrites', 'Soma', 'Axon', 'Myelin sheath', and 'Terminal buttons and synapses'.

- Myelin sheath insulates axons and speeds transmission of signals
- Multiple sclerosis
- De-myelinating disease

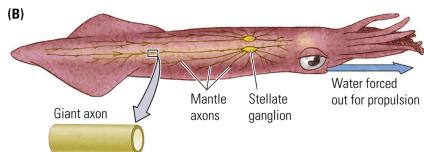
Parts of a neuron

- Terminal buttons
- Secrete neurotransmitters
- Synapse = junction between neurons

Detailed description: The left side of the diagram shows a neuron with labels: 'Collecting information' pointing to the dendrites, 'Integrating information' pointing to the soma, 'Flow of information' pointing to the axon, and 'Sending information' pointing to the terminal buttons. A callout box says: 'Information from other neurons is collected at dendrites,... processed in the cell body,... passed on to the axon,...'. Another callout box at the bottom says: '...then to the end feet, where it is passed on to a target neuron.' The right side shows a 3D rendering of two neurons meeting at a synapse, with red dots representing neurotransmitters being released from the pre-synaptic neuron's terminal buttons.

The neural impulse

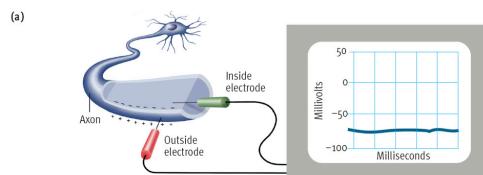
- Hodgkin and Huxley (1952)



- Fluid inside and outside of neuron has ions

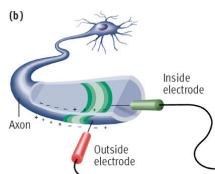
The Resting Potential

outside of cell ++++++++
inside of cell -----

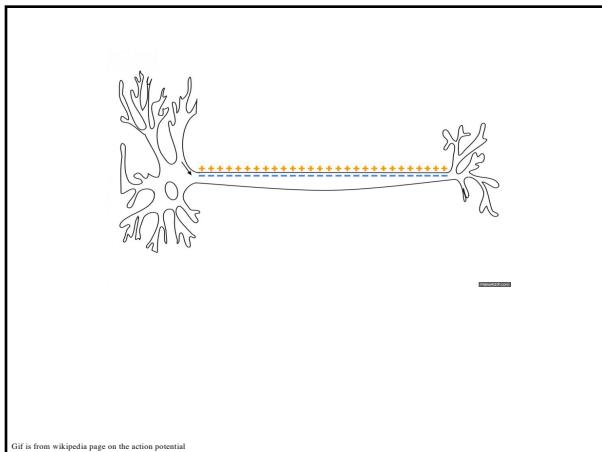


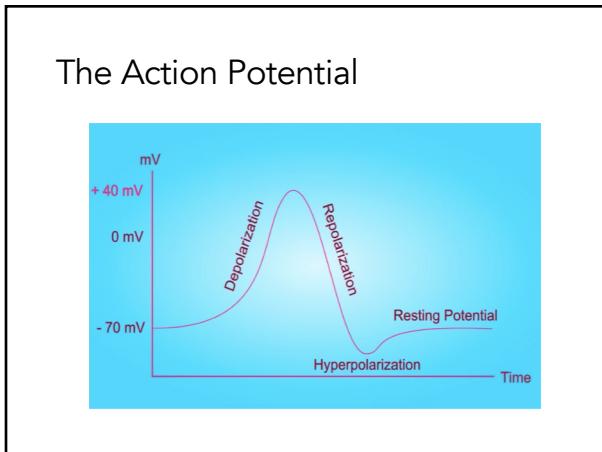
- Resting potential = Stable negative charge of -70 mV

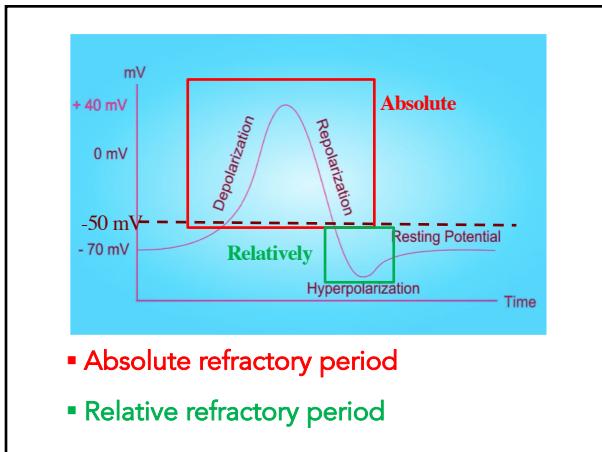
The Action Potential



- Action potential related to changes in ion flow when the cell is stimulated
- Sodium ions (Na^+)

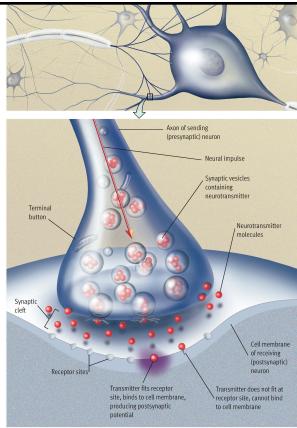






- All-or-none law
- Each action potential:
 - is of the same magnitude
 - has a variable firing rate
 - travels extremely fast

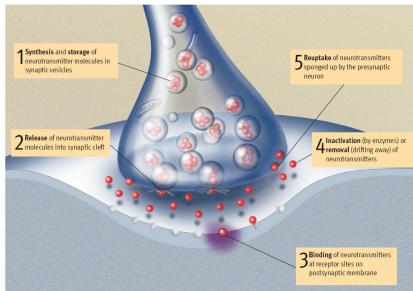
- Neurotransmitter is stored in synaptic vesicles
- Released into synaptic cleft and binds to receptor sites
- Autoreceptors



- Postsynaptic potentials =

Neurotransmitter produces a change in voltage at receptor site
 - Excitatory (EPSP) – depolarizing effect
 - Inhibitory (IPSP) – (hyper)polarizing effect
- NOT the same as an action potential

- Removal of neurotransmitter from the synapse

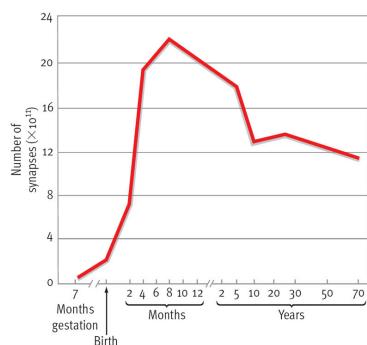


▪ Thinking and movement require LOTS of neurons

▪ Connections between neurons evolve

▪ Long-term potentiation (LTP)

▪ Pruning

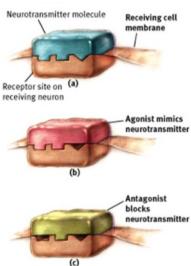


Neurotransmitters

- Different classes of neurotransmitters
 - Small molecule
 - Neuropeptides
 - Other

Neurotransmitter Receptor Sites

- **Agonist** – mimics neurotransmitter action
 - Acetylcholine (agonist = nicotine)
- **Antagonist** – opposes action of a neurotransmitter
 - Acetylcholine (antagonist = curare)



Common Neurotransmitters and Some of Their Functions

NEUROTRANSMITTER	CHARACTERISTICS AND RELATIONS TO BEHAVIOUR	DISORDERS ASSOCIATED WITH DYSREGULATION
Acetylcholine (ACh)	Released by motor neurons controlling skeletal muscles Contributes to the regulation of attention, arousal, and memory Some ACh receptors stimulated by nicotine	Alzheimer's disease
Dopamine (DA)	Contributes to control of voluntary movement Cocaine and amphetamines elevate activity at DA synapses Dopamine release in medial forebrain bundle characterized as "reward pathway"	Parkinsonism Schizophrenic disorders Addictive disorders
Norepinephrine (NE)	Contributes to modulation of mood and arousal Cocaine and amphetamines elevate activity at NE synapses	Depressive disorders
Serotonin	Involved in regulation of sleep and wakefulness, eating, aggression Prozac and similar antidepressant drugs affect serotonin circuits	Depressive disorders Obsessive-compulsive disorders Eating disorders
GABA	Serve as widely distributed inhibitory transmitter, contributing to regulation of anxiety and sleep-arousal Valium and similar anti-anxiety drugs work at GABA synapses	Anxiety disorders
Endorphins	Resemble opiate drugs in structure and effects Play role in pain relief and response to stress Contribute to regulation of eating behaviour	

