

**Edexcel - A-Level Biology A - 2015**

		Nervous System Controls & Responds to Body Functions & Directs Behavior						Nervous System Structure & Function Are Determined By Both Genes & Environment Throughout Life							The Brain is the Foundation of the Mind				Research Leads to Essential Understanding for Therapies															
		1. Brain is the body's most complex organ.			2. Neurons communicate using electrical and chemical signals.			3. Genetically determined circuits are foundation of the nervous system.			4. Life experiences change the nervous system.				5. Intelligence arises as brain reasons, plans, solves problems.		6. The brain makes it possible to communicate knowledge through language.		7. Human brain endows us with a natural curiosity to understand how the world works.		8. Fundamental discoveries promote healthy living and treatment of disease.													
Topic	Learning Objective	a	b	c	d	e	f	a	b	c	d	e	f	g	a	b	c	d	e	f	g	a	b	c	d	a	b	a	b	c	a	b	c	d
1.0 Lifestyle, Health and Risk	1.7 Know how factors such as genetics, diet, age, gender, high blood pressure, smoking and inactivity increase the risk of cardiovascular disease (CVD).				*	*									*																			
	1.17 Be able to discuss the potential ethical issues regarding the use of invertebrates in research.																												*			*		
2.0 Genes and Health																																		
3.0 Voice of the Genome																																		
	3.2 Know the ultrastructure of eukaryotic cells, including nucleus, nucleolus, ribosomes, rough and smooth endoplasmic reticulum, mitochondria, centrioles, lysosomes, and Golgi apparatus.		*						*																		*							
	3.3 Understand the role of the rough endoplasmic reticulum (rER) and the Golgi apparatus in protein transport within cells, including their role in the formation of extracellular enzymes.		*						*																		*							
	3.5 Be able to recognise the organelles in 3.2 from electron microscope (EM) images.		*						*																		*							
	3.11 i) Understand what is meant by the terms 'stem cell, pluripotency and totipotency'. ii) Be able to discuss the way society uses scientific knowledge to make decisions about the use of stem cells in medical therapies.	*				*									*												*		*	*	*	*		
	3.12 Understand how cells become specialised through differential gene expression, producing active mRNA leading to synthesis of proteins, which in turn control cell processes or determine cell structure in animals and plants, including the lac operon.	*				*									*												*		*	*	*	*		
	3.14 i) Understand how phenotype is the result of an interaction between genotype and the environment. ii) Know how epigenetic changes, including DNA methylation and histone modification, can modify the activation of certain genes. iii) Understand how epigenetic changes can be passed on following cell division.					*									*												*		*	*	*	*		
4.0 Biodiversity and Natural Resources																																		
	4.3 Understand the concept of niche and be able to discuss examples of adaptation of organisms to their environment (behavioural, physiological and anatomical).				*				*	*	*	*	*	*		*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*
	4.4 Understand how natural selection can lead to adaptation and evolution.			*					*						*												*		*	*	*	*	*	*
	4.13 Understand the development of drug testing from historic to contemporary protocols, including William Withering's digitalis soup, double blind trials, placebo, three-phased testing.				*																						*	*	*	*	*	*	*	*
5.0 On the Wild Side																																		
	5.17 Understand how evolution (a change in the allele frequency) can come about through gene mutation and natural selection.				*				*						*												*		*	*	*	*	*	*
	5.18 Understand the role of the scientific community (scientific journals, the peer review process, scientific conferences) in validating new evidence, including proteomics and genomics, that supports the accepted scientific theory of evolution.				*				*						*												*		*	*	*	*	*	*
6.0 Immunity, Infection and																																		
7.0 Run for your Life																																		
	7.1 Know the way in which muscles, tendons, the skeleton and ligaments interact to enable movement, including antagonistic muscle pairs, extensors and flexors.					*			*																		*		*	*	*	*	*	*
	7.2 Understand the process of contraction of skeletal muscle in terms of the sliding filament theory, including the role of actin, myosin, troponin, tropomyosin, calcium ions (Ca <sup>2+</sup> ), ATP and ATPase.					*			*						*												*		*	*	*	*	*	*
	7.8 i) Know the myogenic nature of cardiac muscle. ii) Understand how the normal electrical activity of the heart coordinates the heart beat, including the roles of the sinoatrial node (SAN), the atrioventricular node (AVN), the bundle of His and the Purkinje fibres. iii) Understand how the use of electrocardiograms (ECGs) can aid the diagnosis of cardiovascular disease (CVD) and other heart conditions.					*			*																		*		*	*	*	*	*	*
	7.10 i) Know the structure of a muscle fibre. ii) Understand the structural and physiological differences between fast and slow twitch muscle fibres.					*			*																		*		*	*	*	*	*	*
	7.11 i) Understand what is meant by negative feedback and positive feedback control. ii) Understand the principle of negative feedback in maintaining systems within narrow limits.		*	*					*																		*		*	*	*	*	*	*
	7.12 Understand homeostasis and its importance in maintaining the body in a state of dynamic equilibrium during exercise, including the role of the hypothalamus and the mechanisms of thermoregulation.		*	*					*																		*		*	*	*	*	*	*
	7.13 Understand the analysis and interpretation of data relating to possible disadvantages of exercising too much (wear and tear on joints, suppression of the immune system) and exercising too little (increased risk of obesity, cardiovascular disease (CVD) and diabetes), recognising correlation and causal relationships.			*	*				*																		*		*	*	*	*	*	*
8.0 Grey Matter																																		
	8.1 Know the structure and function of sensory, relay and motor neurones including the role of Schwann cells and myelination.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8.2 i) Understand how the nervous systems of organisms can cause effectors to respond to a stimulus. ii) Understand how the pupil dilates and contracts.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8.3 Understand how a nerve impulse (action potential) is conducted along an axon including changes in membrane permeability to sodium and potassium ions and the role of the myelination in saltatory conduction.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8.4 Know the structure and function of synapses in nerve impulse transmission, including the role of neurotransmitters, including acetylcholine.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8.5 Understand how the nervous systems of organisms can detect stimuli with reference to rods in the retina of mammals, the roles of rhodopsin, opsin, retinal, sodium ions, cation channels and hyperpolarisation of rod cells in forming action potentials in the optic neurones.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8.7 Understand how co-ordination is brought about through nervous and hormonal control in animals.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8.8 Know the location and functions of the cerebral hemispheres, hypothalamus, cerebellum and medulla oblongata in the human brain.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8.9 Understand how magnetic resonance imaging (MRI), functional magnetic resonance imaging (fMRI), positron emission tomography (PET) and computed tomography (CT) scans are used in medical diagnosis and the investigation of brain structure and function.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	8.10 Understand what happens during the critical period so that mammals can develop their visual capacities to the full.			*					*						*	*											*		*	*	*	*	*	*
	8.11 Understand the role animal models have played in the research into human brain development and function, including Hubel and Wiesel's experiments with monkeys and kittens.			*					*						*	*											*		*	*	*	*	*	*
	8.12 Be able to discuss moral and ethical issues relating to the use of animals in medical research from two ethical standpoints.			*					*						*	*											*		*	*	*	*	*	*
	8.14 Understand how imbalances in certain, naturally occurring brain chemicals can contribute to ill health, including dopamine in Parkinson's disease and serotonin in depression, and to the development of new drugs.			*					*						*	*											*		*	*	*	*	*	*
	8.15 Understand the effects of drugs on synaptic transmissions, including the use of L-Dopa in the treatment of Parkinson's disease and the action of MDMA in Ecstasy.			*					*						*	*											*		*	*	*	*	*	*
	8.16 Understand how the outcomes of genome sequencing projects are being used in the development of personalised medicine and the social, moral and ethical issues this raises.			*					*						*	*											*		*	*	*	*	*	*
	8.17 Know how drugs can be produced using genetically modified organisms (plants, animals and microorganisms).			*					*						*	*											*		*	*	*	*	*	*
	8.18 Understand the risks and benefits associated with the use of genetically modified organisms.			*					*						*	*											*		*	*	*	*	*	*
	8.19 Understand the methods used to investigate the contributions of nature and nurture to brain development, including evidence from the abilities of new-born babies, animal experiments, studies of individuals with damaged brain areas, twin studies and cross-cultural studies.			*					*						*	*											*		*	*	*	*	*	*

KEY		Description	
Nervous System Controls and Responds to Body Functions and Directs Behavior	1. The brain is the body's most complex organ.	a	There are a hundred billion neurons in the human brain, all of which are in use.
		b	Each neuron communicates with many other neurons to form circuits and share information.
		c	Proper nervous system function involves coordinated action of neurons in many brain regions.
		d	The nervous system influences and is influenced by all other body systems (e.g., cardiovascular, endocrine, gastrointestinal and immune systems).
		e	Humans have a complex nervous system that evolved from a simpler one.
		f	This complex organ can malfunction in many ways, leading to disorders that have an enormous social and economic
	2. Neurons communicate using electrical and chemical signals.	a	Sensory stimuli are converted to electrical signals.
		b	Action potentials are electrical signals carried along neurons.
		c	Synapses are chemical or electrical junctions that allow electrical signals to pass from neurons to other cells.
		d	Electrical signals in muscles cause contraction and movement.
		e	Changes in the amount of activity at a synapses can enhance or reduce its function.
		f	Communication between neurons is strengthened or weakened by an individual's activities, such as exercise, stress, and drug use.
		g	All perceptions, thoughts, and behaviors result from combinations of signals among neurons.
	Nervous System Structure and Function are Determined by Both Genes and Environment Throughout Life	3. Genetically determined circuits are foundation of the nervous system.	a
b			Sensory circuits (sight, touch, hearing, smell, taste) bring information to the nervous system, whereas motor circuits send information to muscles and glands.
c			The simplest circuit is a reflex, in which sensory stimulus directly triggers an immediate motor response.
d			Complex responses occur when the brain integrates information from many brain circuits to generate a response.
e			Simple and complex interactions among neurons take place on time scales ranging from milliseconds to months.
f			The brain is organized to recognize sensations, initiate behaviors, and store and access memories that can last a lifetime.
4. Life experiences change the nervous system.		a	Differences in genes and environments make the brain of each animal unique.
		b	Most neurons are generated early in development and survive for life.
		c	Some injuries harm nerve cells, but the brain often recovers from stress, damage, or disease.
		d	Continuously challenging the brain with physical and mental activity helps maintain its structure and function - "use it or lose it."
		e	Peripheral neurons have greater ability to regrow after injury than neurons in the brain and spinal cord.
		f	Neuronal death is a natural part of development and aging.
		g	Some neurons continue to be generated throughout life and their production is regulated by hormones and experience.
		The Brain is the Foundation of the Mind	5. Intelligence arises as brain reasons, plans, and solves problems.
b	Emotions are based on value judgments made by our brains and are manifested by feelings as basic as love and anger and as complex as empathy and hate.		
c	The brain learns from experiences and makes predictions about best actions in response to present and future challenges.		
d	Consciousness depends on normal activity of the brain.		
6. The brain makes it possible to communicate knowledge through language.	a		Languages are acquired early in development and facilitate information exchange and creative thought.
	b		Communication can create and solve many of the most pressing problems humankind faces.
Research Leads to Essential Understanding for Therapies	7. The human brain endows us with a natural curiosity to understand how the world works.	a	The nervous system can be studied at many levels, from complex behaviors such as speech or learning, to the interactions among individual molecules.
		b	Research can ultimately inform us about mind, intelligence, imagination, and consciousness.
		c	Curiosity leads us to unexpected but surprising discoveries that can benefit humanity.
	8. Fundamental discoveries promote healthy living and treatment of disease.	a	Experiments on animals play a central role in providing insights about the human brain and in helping to make healthy lifestyle choices, prevent disease, and find cures for disorders.
		b	Research on humans is an essential final step before new treatments are introduced to prevent or cure disorders.
		c	Neuroscience research has formed the basis for significant progress in treating a large number of disorders.
		d	Finding cures for disorders of the nervous system is a social imperative.