	ogy B - 2015			_		s & Direct		ponds to navior							unction Are nent Through				the N	Foundation /lind 6. The brain makes it	U	ndersta	h Leads t anding fo	r The	erapie
		1. Brain is	s the body orga		nplex	2. Neurons		nicate using nical signals.				lly determine n of the nerv			. Life experiences sys	change th tem.	e nervous	5. Intelligence ari brain reasons, pl solves problen	ises as lans,		7. Huma us w curiosit	an brain ei vith a natu sy to undei ne world w	ıral d rstand	8. Fund iscoverid healthy eatment	ies proi / living :
Topic odule 2: Cells, chemicals for life,	Learning Objective	a b	c	d e	f	a b	с	d e	f	g a	a b	c d	e	f a	b c	d e	f g	a b c	d	a b	a	b	c a	b	c
ansport and gas exchange 1 Cells and chemicals for life 1.1 Cells and microscopy	(a) (i) the importance of microscopy in the development of the cell theory as a unifying concept in biology and the																								
	investigation of cell structure. To include the use of the light microscope, transmission and scanning electron microscopes and recent developments such as the confocal scanning	•					•														•				
	microscope (g) the ultrastructure of a typical eukaryotic animal cell, such as a leucocyte, as revealed by an electron microscope. To include the structure and function of the following: plasma																								
	<u>membrane, Golgi apparatus, rough endoplasmic reticulum</u> (RER) and smooth endoplasmic reticulum (SER), ribosomes, lysosomes, vesicles, mitochondria, cytoskeleton, centrioles.	•					•														•				
 1.2 Water and its importance in ants and animals 1.3 Proteins and enzymes 1.4 Nucleic acids 																									
2 Transport and gas exchange stems 2.1 The heart and monitoring heart																									
nction 2.2 Transport systems in mammals 2.3 Gas exchange in mammals and ants																									
4 Transport systems in plants odule 3: Cell division, velopment and disease control Cell division and development																									
.1 The developing cell: cell divisior d cell differentiation	n (e) (i) the differentiation of stem cells into specialised cells. <u>To include an appreciation of the differences between</u> <u>totipotent, pluripotent and multipotent stem cells, and the</u> <u>differentiation of bone marrow stem cells into specialised</u>	•			•									•			•				•		•	•	
	blood cells. (ii) current applications and uses of stem cells. To include the use of hone marrow stem cells																								
	(i) the production and use of karyotypes. To include the use of karyotypes in fetal sex identification and the diagnosis of chromosomal mutations. To include Down's syndrome, Klinefelter's syndrome and Turner's syndrome (no details of				•									•									•	•	•
3 The development of species: lution and classification	non disiunction are required at AS level). (e) (i) behavioural, physiological and anatomical adaptations to the environment. To include the following adaptations in Homo sapiens: tool use and cultural adaptations for social																								
Dath against immunity and	bonding (behavioural), lactose tolerance and skin pigmentation (physiological), bipedalism and brain size (anatomical)				•						•	• •		• •				•		• •					
Pathogens, immunity and ease control .1 Pathogenic microorganisms .2 The immune system																									
3 Controlling communicable eases Non-communicable diseases 1 The cellular basis of cancer and																									
atment .2 Respiratory diseases and atment	(f) the design and use of clinical trials to assess the value of treatments. To include the role of each phase of a clinical trial and the importance of the recruitment and size of				•					T											•	•		•	•
	sample, randomisation, placebos and double-blind trials. (g) the role of NICE (The National Institute for Health and Care Excellence) in providing guidelines for treatments.To																								
dule 4: Energy, reproduction and	include its role in providing guidelines on clinical practice, health technologies and public health AND the importance of economic considerations in the production of guidelines.																								
pulations Energy, metabolism and exercise .1 Cellular respiration .2 Metabolism and exercise	e (I) the sliding filament theory of muscle contraction. To																								
2 Mammalian reproduction	<u>include the role of actin, myosin, troponin,</u> <u>tropomyosin, the importance of the power stroke and the</u> role of ATP and calcium ions.							•			•														
.1 Fertility and assisted production .2 The effects of ageing on the																									
roductive system Photosynthesis, food productior I populations .1 Photosynthesis, food productior	n																								
d management of the environment 3.2 The impact of population rease																									
From flowers to food dule 5: Genetics, control and neostasis																									
Genetics in the twenty first ntury .1 Patterns of inheritance	(b) gene mutations. To include cystic fibrosis, sickle cell anaemia, phenylketonuria (PKU) and Huntington's disease.				•					•	•			•									•	•	
.2 Population genetics and	 (f) chromosome mutations in humans. To include non- disjunction and translocations in the context of Turner's syndrome, Klinefelter's syndrome and Down's syndrome. (f) epigenetics in terms of the effect of environment on gene 				•					•	,			•									•	•	•
genetics	expression. To include theories of the role of DNA methylation and histones in gene expression AND a review of some human epigenetic studies (such as the Norrbotten				•						,			•									•	•	
.3 Gene technologies	studies, studies on the effect of the Dutch Hunger Winter and twin studies) and possible implications from these studies (f) the use of genetic engineering in eukaryotic cells. To																								
	include an outline of the use of genetic engineering to develop knockout mice as models for studying mammalian diseases (no details of genetic crossing to obtain homozygous individuals are required) AND an outline of the				•						,			•							•		•	•	
	use of genetic engineering to produce human proteins in animals and genetically modified crops (g) somatic and germ line gene therapy. To include the differences between the two forms of gene therapy AND the																								
	ethical implications of gene therapy in disease treatment to include the treatment of cystic fibrosis and SCID (severe combined immunodeficiency disease).				•									•							•		•	•	•
2 Nervous control	(h) the principles of RNA interference. To include in outline only the action of siRNA and miRNA and the potential of RNA interference in disease treatment.				•					•	•			•							•		•	•	•
1.1 The nervous system and the entification and consequences of mage	(a) (i) the organisation of the somatic and autonomic nervous system in humans (ii) practical observations of nervous tissue using a light microscope. To include the use of diagrams, photomicrographs and electron micrographs to	• •	•	• •		•••	•	•			•	•••	•		•	•	•				•				
	show the structure of the central and peripheral nervous system (b) the structure and function of the human brain. To include the use of diagrams, photomicrographs and electron																								
	micrographs of the locations of the cerebrum, cerebellum, medulla oblongata, hypothalamus and pituitary gland and the functions of each area.	•	•			• •	•		•	•	•	• •		•	•	•									
	(c) the structure of motor, sensory and relay neurones. To include the use of diagrams, photomicrographs and electron micrographs to show axons, dendrons and dendrites, cell surface membrane and cell body, myelin sheath and nodes of	•				• •	•	•			•	•	•												
	Ranvier. (d) the establishment of the resting potential and the transmission of the action potential in neurones. To include the interpretation of graphs showing changes in membrane	•				•	•	•			•	•	•												
	potential, the significance of the myelin sheath and the refractory period in the transmission of nerve impulses. (e) the structure and function of synapses in integrating responses in the nervous system. To include the role of																								
	neurotransmitters in excitatory and inhibitory post synaptic potential. (f) (i) the nature of a reflex arc, the use of reflexes and the	•					•	•	•					•		•		•			•				
	<u>differences when compared to a reaction.</u> (ii) practical investigations into reflexes in humans. (iii) practical investigations into factors affecting reaction times.					• •		•			•	•	•												
	Reflexes to include the use of the blink reflex, iris reflex and plantar reflex in assessing nervous system damage and levels of consciousness AND the use of the Student's t-test in																								
	(g) the use of brain scans in assessing brain and spinal cord damage. To include the assessment of traumatic brain injury and strokes and scans to include CT, MRI, fMRI and PET scans									•		•	•								•	•	•	•	•
	and EEGs. (h) the consequences of brain and spinal cord damage. To include effects on memory, motor skills, speech and hormonal imbalance and the ethical consequences of	• •	•	• •		• •	•	•		•	•	• •	•	• •	• •	•					•		•	•	
	establishing brain death should be discussed. (i) the use of drugs to modify brain activity and function. To include the therapeutic use of drugs, such as dopamine for the treatment of Parkinson's disease and the effect of	• •	•	• •		• •	•	•				••	•		•	•					•			•	
	heroin, cannabis, methamphetamine and alcohol on synapse activity in the brain. (j) psychological and physical drug dependency. To include the biological basis of dependency and the consequences of	• •	•	• •		• •		•		•		• •	•	•	• •						•				
.2 Monitoring visual function	dependency on individuals and society. (a) the structure of the eye. To include the location and function of the sclera, conjunctiva, cornea, iris, pupil, lens,	•				•					•														
	 <u>ciliary body, aqueous humour, vitreous humour, choroid, and</u> retina. (b) (i) the structure of the retina. (ii) practical observations of sections through the eye. 																								
	To include the structure and function of the following: rod cells, cone cells, bipolar cells and ganglion cells, the fovea and the blind spot. (c) the function of the retina as a receptor of light stimuli	•				•					•														
	and as a transducer. (d) the assessment of receptor activity through routine eye tests. To include tests for visual acuity, colour vision and OCT	•				•				•	•	•	•								•	•	•	•	
3 The effect of ageing on the ous system	 scans (optical coherence tomography). (a) the symptoms and possible causes of Alzheimer's disease. To include histological changes in brain tissue, cognitive impairment and behavioural changes, and genetic and 				•						,			•									•	•	
	environmental causes. (b) (i) the effect of ageing on the nervous system. (ii) practical investigations into the effect of ageing on reaction times and memory.																								
	To include hearing impairment, visual impairment (cataracts, glaucoma and macular degeneration) and memory loss and the analysis and interpretation of secondary data from				•					•	•	••	•	• •	••	• •	•••						•	•	
Iomeostasis The principles and importance omeostasis	(a) the general principles of homeostasis in the maintenance of a stable internal environment. To include the role of																								
	receptors, effectors and negative feedback AND the concept of normal ranges for temperature, pH, blood glucose concentration and blood pressure. AND contrast positive and negative feedback systems using oxytocin as an example of		•	•																					
	nositive feedback (b) the nervous and hormonal control of heart rate. To include the roles of the sympathetic and parasympathetic	•	•	•		•	•	•																	
	nervous system and adrenaline. (c) the control of body temperature. To include the role of peripheral temperature receptors, the thermoregulatory centre in the hypothalamus and the responses to rising and	•	•	•		•	•	•																	
	falling temperatures (sweating, shivering, vasoconstriction and vasodilation). (d) the regulation of thyroxine release and the effect of thyroxine on metabolic rate.		•	•																					
.2 The hormonal control of blood cose and the management of betes .3 Kidney functions and	 (b) the regulation of blood glucose by negative feedback.To include details of the action of insulin and glucagon at a cellular level. (d) the role of the kidney in osmoregulation. To include the 		•	•																					
Ifunctions	<u>Iocation and role of osmoreceptors, the secretion of ADH</u> <u>from the posterior pituitary, the action on ADH at the</u> <u>collecting ducts, the role of cyclic AMP in collecting duct cells</u>		•	•																					
	and the insertion and removal of aquaporins into cell surface membranes (e) the role of the kidney as an endocrine gland. To include an outline of the homeostatic function of erythropoietin		•	•																					
	(EPO) and renin (angiotensin). (i) the future for transplant surgery. To include the																								-

KEY			Description							
Nervous System Controls	1. The brain is the body's most	а	There are a hundred billion neurons in the human brain, all of which are in use.							
and Responds to Body complex organ. Functions and Directs		b	Each neuron communicates with many other neurons to form circuits and share information.							
		с	Proper nervous system function involves coordinated action of neurons in many brain regions.							
Behavior		d	The nervous system influences and is influenced by all other body systems (e.g., cardiovascular, endocrine, gastrointestinal and immune systems).							
		е	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.							
		с	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.							
		е	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		a	Neuronal circuits are formed by genetic programs during embryonic development and modified through interactions with							
and Function are	and Function are circuits are foundation of the		the internal and external environment. Sensory circuits (sight, touch, hearing, smell, taste) bring information to the nervous system, whereas motor circuits send							
Determined by Both	nervous system.	a	information to muscles and glands.							
Genes and Environment		с	The simplest circuit is a reflex, in which sensory stimulus directly triggers an immediate motor response.							
Throughout Life		d	Complex responses occur when the brain integrates information from many brain circuits to generate a response.							
, C		е	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.	а	Differences in genes and environments make the brain of each animal unique.							
		b	Most neurons are generated early in development and survive for life.							
		с	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."							
		е	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	5. Intelligence arises as brain reasons, plans, and solves	a	The brain makes sense of the world by using all available information, including senses, emotions, instincts, and remembered experiences.							
Foundation of the Mind	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.							
		с	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	а	Languages are acquired early in development and facilitate information exchange and creative thought.							
	to communicate knowledge through language.	b	Communication can create and solve many of the most pressing problems humankind faces.							
Research Leads to	7. The human brain endows us	a	The nervous system can be studied at many levels, from complex behaviors such as speech or learning, to the interactions							
Essential Understanding	with a natural curiosity to		among individual molecules.							

for Therapies		understand how the world	b	Research can ultimately inform us about mind, intelligence, imagination, and consciousness.									
	for inerapies	works.	c	Curiosity leads us to unexpected but surprising discoveries that can benefit humanity.									
		8. Fundamental discoveries	а	Experiments on animals play a central role in providing insights about the human brain and in helping to make healthy									
		promote healthy living and treatment of disease.		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.									
			С	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.									