**PAST PAPER ESSAYS THAT HAVE COME UP IN THE PAST:**

OVERALL EXAMINERS REPORT:

Some candidates produced lengthy introductions and conclusions that were no more than synopses of what was going to be or had been written. Clearly this wastes time that would better be spent providing appropriate detail.

The plans revealed that some candidates felt that they had to include something from every unit. This led to the occasional incorporation of odd topics which resulted in the withholding of marks for relevance.

The use of footnotes and asterisks detracted from overall coherence and allowed only limited marks to be awarded for Quality of Written Communication

1. **Carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects (2010)**

MARK SCHEME:

Carbon dioxide affects the physiology of organisms - Pulmonary ventilation and the mechanism of breathing / Light-independent reaction of photosynthesis. Limiting factors / Role of chemoreceptors in controlling heart rate

The direct effects of increasing carbon dioxide concentration - Respiration, photosynthesis and human activity giving rise to short-term fluctuations and long-term change / Yield of crop plants / Carbon cycle

Indirect effects of increasing carbon dioxide concentration - Role of carbon dioxide in producing global warming / Life cycles and number of insect pests / Distribution of animals and plants / Effect of temperature on enzymes;

1. **The causes of disease in humans. (2010)**

MARK SCHEME

Pathogens - Pathogens include bacteria, viruses and fungi / Pathogens cause disease by damaging cells and producing toxins / Cholera bacteria produce toxins resulting in diarrhoea / Symptoms and transmission of pulmonary tuberculosis / Horizontal gene transmission and MRSA

Lifestyle - Risk factors associated with cancer and coronary heart disease / The effects of fibrosis, asthma and emphysema on lung function / The biological basis of heart disease

Genetics - Differences in bases may lead to non-functional enzymes / Relationship between the cell cycle and cancer / Proto-oncogenes and tumour suppressor genes / Gene mutations

1. **Using DNA in science and technology (2011)**

MARK SCHEME

DNA and classification - Structure of DNA / Differences in DNA lead to genetic diversity / Comparison of DNA base sequences / DNA hybridisation

Genetic engineering and making useful substances – Plasmids / The use of recombinant DNA to produce transformed organisms that benefit humans

Other uses of DNA - Cell cycle and treatment of cancer / Gene therapy; Medical diagnosis and the treatment of human disease; The use of DNA probes to screen patients for clinically important genes

EXAMINERS REPORT:

* Many answers didn’t include the role of DNA in the classification of organisms
* Understanding of techniques was often extremely limited, particularly in vivo gene cloning and the use of markers

1. **A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next cycle. Write an essay about cycles in biology. (2011)**

MARK SCHEME:

Ecological cycles - Nutrient cycles / Carbon cycle / Nitrogen cycle

Biochemical cycles - Enzyme action / Synthesis of ATP from ADP / Light-independent reaction / The Krebs cycle

Physiological and genetic cycles - The mechanism of breathing / The cardiac cycle / The cell cycle / Muscle contraction / Oestrous cycle

1. **The importance of shapes fitting together in cells and organisms. (2012)**

MARK SCHEME:

Proteins & Enzymes - Enzyme properties (induced fit model) and digestion / enzyme inhibitors reducing action rate. Mutation leading to non-functional / Protein structure / Plasma membrane structure and cell transport / Antigens, antibodies, B cells & T cells / Vaccines

Nucleic Acids - Structure of DNA / DNA Replication (not PCR) / Transcription & translation / Transcriptional factors, oestrogen, siRNA / Restriction enzymes

Physiology - Haemoglobin / Action potentials & synaptic transmission / Muscle contraction / Control of blood glucose concentration / Control of mammalian oestrous cycle

EXAMINERS REPORT:

* In terms of material beyond the specification, there were some truly excellent accounts of how faulty chloride ion channels cause the production of thicker mucus in cystic fibrosis sufferers.
* A minority of students wrote about the polymerase chain reaction (PCR) and DNA hybridisation. These were not classed as relevant as they do not occur ‘in cells and organisms’.

1. **How bacteria can affect the lives of humans and other organisms. (2012)**

MARK SCHEME

Bacteria & Disease - Pathogens / Lactose intolerance / Cholera /Tuberculosis / Resistance to antibiotics

Ecological Importance - Carbon cycle / Nitrogen cycle / Eutrophication

Making Use of Bacteria - Use of bacterial enzymes e.g. restriction endonuclease, DNA polymerase for PCR / Use of bacterial plasmids e.g. in vivo gene cloning, genetically-modified crops, gene therapy / Use of bacteria to produce useful chemicals

EXAMINERS REPORT:

* Unfortunately, some students wrote in unnecessary detail about the worldwide distribution of cholera and how the disease can be treated or avoided.
* Some students gave long, unnecessary descriptions of how the immune system responds to a pathogen, without any context regarding how bacteria affect the lives of humans.
* Weaker students described saprobiotic bacteria ‘returning carbon to the soil’, rather than returning carbon dioxide to the air by respiration.
* Weak responses typically referred to plants taking up nitrogen, rather than nitrates.
* There was also confusion regarding nitrogen fixation and nitrification. A common misconception that was seen is that nitrogen fixation is the first stage in nitrification, rather than a separate process in its own right.
* Similarly, a minority of students thought that bacteria can colonise bare rock and are therefore responsible for primary succession.
* A number of misconceptions were seen; They included injecting bacteria containing the human insulin gene into diabetics and placing the plasmid into a virus.
* Indeed, some students thought that a bacteriophage and a bacterium are the same thing.
* There were some excellent accounts by the best students of how plasmids can be attached to liposomes in order to alleviate the symptoms of cystic fibrosis. These were awarded extra credit. Similarly, the roles of bacteria in producing vitamin K in the Human digestive system, producing cellulase in the digestive system of cattle and breaking down oil spills were also seen.

1. **The membranes of different types of cells are involved in many different functions. (2013)**

MARK SCHEME:

* The emphasis in answers should be on the involvement of membranes in processes, not just the processes themselves
* Breadth should include  Membranes – basic functions / Organelle membranes / Cell surface membranes/ Processes – eg protein secretion, synaptic transmission, cell division

Membrane function as selectively permeable / Transport mechanisms across membranes / Absorption and co-transport of sodium ions and glucose / Photosynthesis, chloroplast, thylakoids / Respiration, mitochondrion and cristae / Protein secretion, RER, SER and Golgi / Surface receptors and antigen and immune response / Cell division / Vertical and horizontal transmission – membranes and bacteria / Pacinian corpuscle / Tropisms – movement of IAA / Nerve impulses/action potentials / Synaptic transmission / Muscle contraction, calcium ion movement/storage / Hormones - eg Blood glucose regulation – insulin and glucagon / Osmosis, including water movement in plants

EXAMINERS REPORT:

* The role of thylakoid membranes in photosynthesis – Only the best examples gave these as the location of photosynthetic pigments and the electron transport chains, as well as describing the role of the membrane in the chemiosmotic synthesis of ATP and the production of reduced NADP.
* The roles of membranes involved in protein synthesis and secretion were rarely seen. The nearest that many came was to write about nuclear pores and the passage of mRNA for protein synthesis.
* There were many good descriptions of the roles of membrane-bound receptors, antigens and antibodies in the immune response. These often included the fusion of lysosomes with phagocytic vesicles/vacuoles.
* There were many good descriptions of how proteins in membranes are involved in maintaining resting potentials and producing action potentials.
* With synaptic transmission there was good extension material was often seen. One example seen in a number of essays was the role of GABA in opening chloride ion channels and the inhibitory effect on action potential formation.
* Hormones were frequently written about. The best accounts focused on the involvement of membranes. Many wrote about the lipid nature of oestrogen and how this allowed it to enter through the phospholipid bilayer of cells. Others wrote about insulin but details of its effects on transport of glucose across membranes were relatively rare. Glucagon and adrenaline were also commonly used as examples and frequently involved good outlines of the second messenger concept.

1. **There are many different types of relationships and interactions between organisms. (2013)**

MARK SCHEME:

* The emphasis in answers should be on the relationships and interactions between organisms not just the topics themselves
* Breadth should include - Pathogen and host / Evolution (related topics) / Ecological / Human intervention in relationships

Breadth topics:

Pathogens and effects on host / Cholera / Taxonomy / Classification and evolution / Inheritance and evolution / Genetic code, universal / Behaviour / Populations and evolution, variation between individuals within a species / Relationships within ecosystems – eg predator-prey / Energy transfer in ecosystems / Nutrient cycles, the organisms involved / Succession, biodiversity, species and individuals in a community / Human impacts on the environment and its effect on relationships between organisms – including farming / Gene technology and GMO and selective breeding / Antibiotic resistance

EXAMINERS REPORT:

* There were some good accounts of the interactions between pathogen and host. Extension material was quite often included, usually relating to detailed accounts of the effects of a pathogen not named in the specification.
* The predator-prey relationship was often described but infrequently with references to populations, inter and intra-specific competition or time lags.
* Nutrient cycles - The specification rather limits what they can be expected to know about the carbon cycle but some failed to include any relevant detail.
* The nitrogen cycle was well done by some but there were common misconceptions about what happens in the root nodules of leguminous plants. Many thought that Rhizobium converts nitrogen to nitrates for the plants. There was also considerable confusion between nitrifying and denitrifying bacteria

1. **How cells and organisms carry out exchanges with their external environment to maintain their internal environment. (2014)**

MARK SCHEME:

Homeostasis / Digestion and absorption / Cells / Lung function / Gas exchange / Passage of water through plant / Nutrient cycles / Response to stimuli / Neurones / Temperature control / tissue fluid and its formation / Control of blood glucose concentration / Negative feedback /Gene expression

EXAMINERS REPORT:

* Factual errors were common, such as getting endotherms and ectotherms the wrong way round, writing about blood vessels moving nearer to the skin and capillaries dilating.
* Relatively few students wrote about maintaining a constant, optimum temperature for enzyme activity and metabolic processes generally.
* Some of the commoner extension material content related to stomatal opening and closure mechanisms. These often went into some detail about changes in turgor of guard cells and how stomatal aperture size relates to maintaining gradients for gas exchange and regulating water loss.
* Few accounts of gas exchange referred directly to maintaining internal oxygen concentrations for respiration, or removing carbon dioxide that can lower pH and thus affect enzyme activity.
* It was rare for students to refer to the importance of a (relatively) constant blood glucose concentration to maintain the water potential of blood plasma and a diffusion gradient for entry of glucose into cells for respiration.
* Exchanges by individual cells were often described, in terms of movements across membranes. Only the best accounts made reference to maintaining some aspect of the internal environment of cells, such as how this maintained internal concentrations of essential nutrients.

1. **How energy is transferred within and between organisms. (2014)**

MARK SCHEME:

Photosynthesis / Energy transfer through ecosystems / Food production / Digestion (as in fuel) / Absorption (by cells) / Mass transport / Respiration / ATP / Stimuli and responses / Muscle contraction / Nerve impulses

EXAMINERS REPORT:

* A few included irrelevant paragraphs about transfer of energy between organisms and their abiotic environment.
* With photosynthesis better essays were more selective and wrote about how energy in photons is conserved in chemical bonds during the process.
* With respiration, better essays gave references to how the ATP formed is involved in transfers of energy. Some good accounts did include phosphorylation of glucose at the start of glycolysis, to make it more reactive/less stable. Others wrote about the role of ATP in muscle contraction and covered two topics at once.
* Muscle contraction - good accounts made a point about chemical energy in ATP being conserved/used in movement, or being transduced/transformed into kinetic energy.
* Farming practices are there to try to increase energy transfers to humans.
* A stimulus is a change in energy and many students used responses to stimuli as examples of energy transfers. This topic area also produced quite a few accounts involving extension material; most notably the photo-chemical reactions in rods and cones in the retina and how these are linked to formation of nerve impulses.
* Some students wrote about mass transport systems as examples involving energy transfers. For example, chemical energy from ATP being used by heart muscles that generate force and thus cause movement of blood. Another example used was that of the transpiration stream in plants. Students who wrote about these topics were often the ones who focused clearly on the theme of transfers of energy.

1. **The importance of responses to changes in the internal and external environment of an organism (2015 replacement paper)**

MARK SCHEME:

Transport in and out of cells of specific substances - Immune response - Haemoglobin – Transpiration, response to environmental factors, gas exchange in plants - Behaviour - Adaptation and selection - Changes in populations, selection pressures - Responses to stimuli, plants and tropisms, control of heart rate - Taxes and kineses - Receptors - Control of Heart Rate - Simple reflexes and neurones and synapses - Hormones and responses - Chemical mediators – Homeostasis, response to changes in internal environment - Feedback - Gene expression as part of response

EXAMINERS REPORT:

* As in previous years, the use of examples that any member of the public might use did not gain any extra credit. Extension material has to be at least of A-level standard and accurately described using appropriate scientific terminology.
* Appropriate terminology was often poorly used or absent. For example, many students wrote about ‘signals’ and ‘messages’ rather than impulses/action potentials. The essay is supposed to be written using appropriate terminology, at a level to be expected after two years of A-level study
* With thermoregulation and the control of blood glucose concentration many accounts did not include details of receptors, their location, the coordinator or the effectors.
* Most did identify the importance of thermoregulation in terms of enzyme activity.
* Only better answers included why the changes produced by the control of heart rate were important; for example, in terms of pH and enzyme activity.
* Receptors were also commonly written about, mainly rods, cones and Pacinian corpuscles. Levels of detail varied, as did attempts to explain their importance in responses. Transpiration and control of gas exchange in plants were used as examples by many students. Some good accounts were seen that related changes in transpiration to the environmental stimuli.

1. **The importance to humans of the control of growth, reproduction and development of organisms, including themselves. (2015 replacement paper)**

MARK SCHEME

Pathogens and invasion of human tissues, Antibiotic resistance, control of bacterial growth - Cholera - Immune response and vaccination to control growth of pathogens - Human influence on biodiversity - Human populations - Humans and farming practices, selective breeding - Use of fertilisers and pesticides - Succession and controlling it – Genetics, prediction of inherited conditions - Control of gene expression, stem cells - Regulation of gene expression, prevention, treatment and cure of cancer also related to Mitosis and cancer - Gene cloning and transfer - Gene therapy

EXAMINERS REPORT:

* In relation to farming better students wrote about net productivity and the impact on this of various farming practices
* Better students frequently included accounts of vaccination programmes and resulting herd immunity as ways of controlling pathogen populations and their growth.
* Accounts of various aspects of regulation of gene expression featured in many good essays. This was also a topic area that produced quite a lot of extension material; including some references to epigenetics.

ALL QUESTIONS:

1. **Carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects (2010)**
2. **The causes of disease in humans. (2010)**
3. **Using DNA in science and technology (2011)**
4. **A cycle is a biological pathway or process in which the end product of one cycle becomes the starting point for the next cycle. Write an essay about cycles in biology. (2011)**
5. **The importance of shapes fitting together in cells and organisms. (2012)**
6. **How bacteria can affect the lives of humans and other organisms. (2012)**
7. **The membranes of different types of cells are involved in many different functions. (2013)**
8. **There are many different types of relationships and interactions between organisms. (2013)**
9. **How cells and organisms carry out exchanges with their external environment to maintain their internal environment. (2014)**
10. **How energy is transferred within and between organisms. (2014)**
11. **The importance of responses to changes in the internal and external environment of an organism (2015 replacement)**
12. **The importance to humans of the control of growth, reproduction and development of organisms, including themselves. (2015 replacement)**
13. **The importance of proteins in the control of processes and responses in organisms (2015 original)**
14. **The causes and importance of variation and diversity in organisms (2015 original)**
15. **The control of processes in cells and the importance of these processes (2016)**
16. **The importance of ions in biology (2016)**