***ESSAY PLANS OF POTENTIAL QUESTIONS – BIOLOGY***

Red writing is additional off the specification content

**DNA AND THE TRANSMISSION OF INFORMATION**

* Structure of DNA
* Genes coding for proteins – transcription and translation and the triplet code
* Alterations and mutations in DNA
* Replication by semi-conservative methods
* Mitosis
* Meiosis
* Preventing DNA transcription
* DNA in prokaryotes – conjugation
* Speciation and change in allele frequency

**ENZYMES AND THE FUNCTIONING OF CELLS, TISSUES AND ORGANS**

* Structure; primary, tertiary.
* Active site – lock and key and induced fit model
* Digestion enzymes
* Enzyme inhibitors
* Decomposers digesting waste by secreting enzymes
* DNA semi-conservative replication – enzyme DNA helicase and DNA polymerase.
* Transcription and translation – enzyme DNA helicase and RNA polymerase. Enzymes remove introns. Enzymes bring amino acids together from tRNA
* Photosynthesis – RuBP to GP uses enzyme rubisco
* Respiration – link and krebs cycle use dehydrogenase enzymes. Co-enzymes.
* ATPase during electron transport chain and active transport for both transporting sodium out of axon to generate a resting potential and even to provide energy for muscle contraction and the sliding filament theory.

BITS OF INFORMATION TO REMEMBER:

* Enzymes are biological catalysts
* They control the functions of individual cells and collections of cells (tissues) or collections of tissues (organs)
* They’re globular proteins.
* Salivary amylase turns starch to maltose which is then turned to alpha glucose in intestine. In stomach pepsin turns proteins into smaller peptides and trypsin further breaks it down into amino acids. Glucose then absorbed by sodium-glucose transport where enzyme ATPase releases energy for the pump.
* Decomposers release hydrolytic enzymes like lipase, carbohydrase and protease so the soluble products can then be absorbed and assimilated into useful compounds.
* PHOTOSYNTHESIS – Aphids may be the first photosynthesising organisms. They increase ATP in response to light, hinting that they might photosynthesise. Carotenoids are common in plants to harvest light and Aphids are the only insects with the genes to produce carotenoids.

**MOVEMENT OF SUBSTANCES ACROSS CELL MEMBRANES IN THE FUNCTIONING OF ORGANS AND ORGAN SYSTEMS**

* Organ system – collection of organs working together to perform similar function
* Structure of cell surface membrane
* Diffusion, facilitated diffusion, active transport, osmosis
* Gas exchange system
* Respiration – pyruvate to cross and enter matrix, hydrogen passing through and into inner-membrane space.
* Plants – roots and apoplast (via gaps in cell walls) and symplast (via cytoplasm) pathways
* Excretory system
* Consequences of uncontrolled ion movements – cholera.
* sodium in functioning of neurones
* Calcium in muscle contraction
* Protein synthesis – movement of RNA through nuclear pore

BITS OF INFORMATION TO REMEMBER:

* Lungs 🡪 gases cross through epithelium of alveoli. Intercostal muscles and ventilation. Oxygen diffuses through cells and through the membrane of red blood cells where it loads with haemoglobin.
* Respiration 🡪 oxygen helps increase permeability of mitochondrial membrane allowing pyruvate to cross. Reduced NAD passes its electrons and this increases permeability of channel proteins in the inner membrane to hydrogen so they can pass into inner membrane space
* Active transport of mineral ions into the xylem allows the water to enter by osmosis generating root pressure. This, together with the cohesion-tension, pulls water up the xylem
* Excretory system 🡪 removes waste products like urea. Kidney forms a concentrated urine. The membrane of the kidney tubules allow water to pass out of the kidney while urea is too large to pass out so it remains in the tubule and increases in concentration.
* Cholera 🡪 releases toxin which binds to and opens chloride ion channels on epithelium. They leave, lowering lumen water potential so water is lost form cells. The reabsorption of water requires sodium and glucose which are taken up by co-transport in the small intestine.

**MOVEMENT INSIDE CELLS**

* Membrane phospholipid bilayer
* Diffusion, facilitated diffusion, active transport, osmosis.
* Respiration
* photosynthesis
* Muscle cells
* DNA and transcription & translation
* Mitosis
* Plants and water transport up the xylem
* conjugation
* Movement of sodium in nerve cells

BITS OF INFORMATION TO REMEMBER:

* Mitosis – DNA replicated by semi-conservative method. Chromosomes attach to spindle fibres at cells equator. Prophase – nuclear membrane disintegrates and chromosomes visible. Metaphase – chromosomes allied at centre. Anaphase – centromeres split as spindles contract and pull chromatids to opposite poles. Telophase – each pole now has a set of chromosomes so nuclear envelopes reform. Cytokinesis – cytoplasm splits.
* PHOTOSYNTHESIS – Aphids may be the first photosynthesising organisms. They increase ATP in response to light, hinting that they might photosynthesise. Carotenoids are common in plants to harvest light and Aphids are the only insects with the genes to produce carotenoids.

**ENERGY TRANSFERS INSIDE LIVING ORGANISMS**

* ATP properties – hydrolysed by ATPase to release energy
* Plants produce ATP during light-dependant reaction. Passage of ATP during photosynthesis
* Respiration releases ATP, anaerobic releases less
* Muscle contraction uses ATP
* Synapses use ATP to fuse vesicles with the neurotransmitter.
* Pushing water up plants uses active transport
* Heart contraction uses ATP

BITS OF INFORMATION TO REMEMBER:

* ATP is hydrolysed by ATPase to ADP and Pi and this releases a packet of energy of around 31 KJmol-1
* Photosynthesis – red and blue wavelengths of light are absorbed by chlorophyll and this energy is absorbed and transferred to electrons. As electrons pass along electron carries, the energy released activates ATPase to form ATP
* PHOTOSYNTHESIS – Aphids may be the first photosynthesising organisms. They increase ATP in response to light, hinting that they might photosynthesise. Carotenoids are common in plants to harvest light and Aphids are the only insects with the genes to produce carotenoids.
* Glucose from photosynthesis is used in respiration.
* Respiration also releases heat that provides increased kinetic energy for osmosis and diffusion
* Muscles 🡪 hydrolysis of ATP provides energy for detachment of actomyosin cross-bridges.
* Nervous system 🡪 ATP provides energy to pump three sodiums out the axon and two potassium in to maintain a resting potential of -70mV

**STRUCTURE OF PROTEINS RELATED TO THEIR FUNCTION**

* Structure
* Structural proteins – keratin and collage which are formed from coils that twist to form rope-like structures.
* Protein synthesis by translation
* Muscle made from protein filaments myosin and actin
* Transport proteins – channel and carrier proteins. Sodium channels in neurone membranes, during photosynthesis
* Proteins and the infectivity of pathogens – proteins on surface of pathogens act as antigens to identify the cell. Cholera releases a protein toxin to open chloride ions.
* Enzymes – structure. DNA polymerase in replication and RNA polymerase in transcription.
* Hormones – they have tertiary structure that’s complementary to that of a receptor molecule on the cell-surface membrane of the target cell. E.g. Insulin and FSH
* Haemoglobin

BITS OF INFORMATION TO REMEMBER:

* The combination of the 20 plus amino acids allows an almost infinite number of possible structures and functions.
* Insulin 🡪 released by Beta cells when blood glucose is high. It binds to receptor on the liver and causes activation of an enzyme that condenses glucose to glycogen during glycogenesis.

**TRANSFER THROUGH ECOSYSTEMS**

* Ecosystem = all interactions between all the biotic and abiotic features in a given area at a given time
* Chemical elements, materials and energy are transferred
* Photosynthesis – plants act as producers through transduction of the energy in sunlight and making it available in a chemical form of carbon containing compounds that then is available for consumption by primary consumers.
* Primary consumers eat plants which they assimilate and use for growth, repair and respiration.
* Respiration process releases ATP from glucose
* Energy is used in animal for active transport of sodium into axon and the detachment of actomyosin cross-bridges so some energy is lost to the environment as heat meaning less energy available to secondary consumers so we have a pyramid of biomass.
* Carbon cycle
* nitrogen cycle – nitrogen needed for DNA
* Water is also transferred – it evaporates from sea and condenses as a cloud than falls back as rain. Plants absorb it
* Animals drink the water and its lost back to environment by sweat, urine and from exchange surface of lungs.
* Genetic material is transferred
* Pesticides

BITS OF INFORMATION TO REMEMBER:

* PHOTOSYNTHESIS – Aphids may be the first photosynthesising organisms. They increase ATP in response to light, hinting that they might photosynthesise. Carotenoids are common in plants to harvest light and Aphids are the only insects with the genes to produce carotenoids
* GLOBAL WARMING – February 2016 was 1.35C warmer than 1980. In 2015 the annual rise of Co2 was 3.09 ppm, the highest record
* Global warming and the peppered moth

**WHY OFFSPRING PRODUCED BY SAME PARENTS ARE DIFFERENT IN APPEARANCE.**

* Alleles are different forms of genes
* Variation due to mutation, crossing over, independent segregation and random fusion
* Even identical twins, with same genotype, can vary slightly due to environmental factors (even in animals, environmental factors like availability of nutrients or energy)
* Variation is important as it creates a large gene pool so greater ability to adapt and survive.
* selection

BITS OF INFORMATION TO REMEMBER:

* Offspring inherit genetic information when haploid gametes produced in meiosis fuse to form a zygote which divides to form the embryo
* Characteristics of an organism are encoded within its genes.
* Organisms of same species carry same genes at a given loci, but there’s alternate forms called alleles which give rise to intraspecific variations

**CARBON DIOXIDE IN ORGANISMS AND ECOSYSTEMS**

* Atmosphere has low levels of carbon dioxide.
* CARBON CYCLE
* Human activates – fossil fuels, deforestation
* PHYSIOLOGICAL ROLES:
* Haemoglobin
* Heart rate

BITS OF INFORMATION TO REMEMBER:

* Carbon dioxide transfers carbon atoms between organisms and between them and their environment
* CARBON CYCLE:
* Plants absorb it through stomata and it combines with RuBP and is reduced to TP which then can form larger molecules like glucose and ultimately starch and cellulose. Thus carbon dioxide acted as a source of carbon atoms which were incorporated into the biomass of the plants and therefore become the available biomass of an ecosystem.
* The biomass can then be consumed by herbivores to provide building blocks for growth and repair. Glucose then enters cells where, through respiration, it releases CO2 back into atmosphere
* Plants absorb it and, through photosynthesis, its turned into glucose
* PHOTOSYNTHESIS – Aphids may be the first photosynthesising organisms. They increase ATP in response to light, hinting that they might photosynthesise. Carotenoids are common in plants to harvest light and Aphids are the only insects with the genes to produce carotenoids
* Glucose used by cells and, through respiration, releases carbon dioxide back into atmosphere.
* With global warming, the C=O bonds of the gas trap infrared radiation and prevent it being radiated back
* GLOBAL WARMING – February 2016 was 1.35C warmer than 1980. In 2015 the annual rise of Co2 was 3.09 ppm, the highest record
* PHYSIOLOGICAL ROLES:
* Haemoglobin – more waste carbon dioxide from respiration lowers blood pH so shift moves to right and affinity is reduced so more oxygen in unloaded for respiration.
* Heart rate – increased respiration and carbon dioxide is detected by chemoreceptors in walls of carotid arteries and aorta to increase frequency to cardio-acceleratory centre.

**HOW ARE THE SHAPES OF CELLS RELATED TO THEIR FUNCTIONS**

* Cells become specialised and this changes their shape and structure
* Root cells and water passage
* Leaf cells and photosynthesis
* Starch and glucose co-transport; epithelial cells
* Haemoglobin
* Nerve cell
* Muscle cells
* Enzymes and their active site
* Rod and cone cells – light sensitive pigments
* Bacteria – flagellum for movement, capsule for adhesion

BITS OF INFORMATION TO REMEMBER:

* ROOTS:
* Function is to absorb water and mineral ions from soil and deliver it to the xylem
* LEAF:
* Function is to absorb light for photosynthesis
* Palisade cells on upper surface and absorb specific wavelengths of red and blue light. Block like shape stacked together for high surface area. Many chloroplasts.
* STARCH:
* Polysaccharide formed from glucose and digested by amylase into maltose and then into glucose
* Glucose absorbed by epithelial cells; have microvilli to increase surface area, mitochondria to provide ATP by respiration for sodium and glucose by co-transport.
* NERVE CELLS:
* Cell body of sensory neurones is located off to the side of the axon so as not to interfere with the passage of impulses.

**LIPIDS IN HEALTH AND DISEASE**

* Lipids contain carbon, hydrogen, oxygen and sometimes phosphorous.
* Triglycerides
* Phospholipids
* Cholesterol
* Fat and conserving heat in cold environments
* Diabetes and gluconeogenesis
* Energy rich properties so useful fuels
* Obesity and heart disease; atheroma
* Myelin is a lipid around neurones

BITS OF INFORMATION TO REMEMBER:

* TRIGLYCERIDES – Glycerol head linked by an ester bond to three fatty acid tails by condensation reactions. Tails can be saturated (c-c single bonds) or unsaturated (at least one double bond)
* The tails can be up to approx. 17 carbon atoms long to give rise to the hydrophobic properties and this makes them insoluble and good for storage.
* PHOSPHOLIPIDS – the molecules can move relative to each other (fluid) and have embedded structures (mosaic) which can act as recognition sites for antigens such as those on cholera.
* CHOLESTEROL – ring-like lipid. Adds strength to membrane. Acts as precursor molecule to synthesise other substances like oestrogen and progesterone.
* FAT AND HEAT CONSERVATION – lipids have lower density than water so they’re good thermal insulators so fat under skin minimises heat loss through radiation. In cold climates it is thick so less heat lost meaning animal would need lower respiration rate in order to survive, thus helping to preserve fuel stores.
* DIABETES - Hydrolysis by lipase in adipose tissue releases fatty acids which can be converted to respiratory substances like glucose (during gluconeogenesis) which can be synthesised to provide energy. Helps diabetes as fatty acids can be converted to glucose and thus enable more glucose to be available despite having limited glycogen stores.
* New hormone, Asporosin, can help treat type 2 diabetes. It is released by fat cells and goes to the liver, telling it to release glucose. When glucose levels rise, production of Asporosin is switched off. A study has shown that treating diabetic mice with asprosin-blocking antibodies seems to be working
* USEFUL FUELS – dense number of C-C and C-H bonds make them energy rich. About 9 kcal per gram and can dissolve certain fat soluble vitamins.
* OBESITY – increase risk of coronary heart disease and myocardial infarction by formation of atheroma.

**GENES AND DIVERSITY**

* Genes and DNA – triplets, genetic code, transcription
* Alleles – differences in alleles arise from mutations or from meiosis
* Mutations
* Meiosis; independent segregation, crossing over
* Selection pressure – variations in phenotype and range of alleles contribute to survival of advantageous individuals.
* Natural selection can reduce diversity as less adapted members die out
* Speciation - Adaptions are important when populations become isolated
* DNA hybridisation – compare DNA sequences to see how close two species are

BITS OF INFORMATION TO REMEMBER:

* Polypeptides control the nature and development of organisms and thus genes are responsible for the diversity of life.
* Range of alleles cause continuous variation in, for example, fur length that is affected by polygenes. Some of these alleles will infer a benefit which may eventually change allelic frequency 🡪 natural selection.

**IMPACT OF LIFESTYLE ON HEALTH**

* FOOD:
* Too much fat can cause obesity = high blood pressure and coronary heart disease or myocardial infarction
* Too much sugar – risk of diabetes
* Foods low in minerals like iron and calcium – iron key component of haemoglobin
* LOCATION:
* High altitude where partial pressure of oxygen is low = curve shifts to left.
* Cooler climate = less activation of thermoreceptors
* Lots of air pollution – asthma and pulmonary fibrosis
* PERSONAL CHOICES:
* Smoking
* Personal hygiene – cholera
* exercise

BITS OF INFORMATION TO REMEMBER:

* Health can be defined as the optimal functioning of body and mind
* DIABETES – unresponsive to insulin and so prevents the elevated glucose levels from decreasing to normal which lowers water potential causing tissue dehydration and high blood pressure, increasing risk of aneurysm. New hormone, Asporosin, can help treat type 2 diabetes. It is released by fat cells and goes to the liver, telling it to release glucose. When glucose levels rise, production of Asporosin is switched off. A study has shown that treating diabetic mice with asprosin-blocking antibodies seems to be working
* Lack of iron = fewer red blood cells so reduced respiration and less ATP
* Calcium contribute to hydrolysis of ATP by ATPase which provides energy for detachment and formation of actomyosin cross-bridges so reduced ability to exercise. Less exercise = increased risk of coronary heart disease
* Asthma – Airways become inflamed due to pollen or dust. Lots of mucus formed which constrict airways.
* Pulmonary fibrosis – exposure to pollen and dust causes build up of scar tissue that decreases elasticity of lungs
* SMOKING – exposes lungs to carbon monoxide, tar and mutagenic contents. Carbon monoxide binds irreversibly to haemoglobin so less oxygen transported. Mutagenic agents in tar can alter base sequence of DNA in lung cells which can effect enzymes or could activate proto-oncogenes to permanently switch on mitosis.
* SMOKING increases cancer – New technique for treating cancer called optogenetics. Scientists can reverse cancer in frogs by hacking cells’ electricity with light which shifts the charge of cancer cells, making them healthy again.
* NANOBOTS – nano-sized entities of DNA can deliver drugs in living cockroaches. They travel around and when they interact with certain cells they uncurl and release the drugs they’re carrying in their folds. We can progress this to humans by creating nanobots with certain base sequences that uncurl when contacting specific diseased cells.

**IMPACT OF HUMAN ACTIVITY ON DIVERSITY OF PLANTS AND ANIMALS**

* Diversity = number of different species and the abundance of each species within a community

ACTIVITY:

* Burning fossil fuels
* Deforestation
* Farming
* Artificial selection
* Conservation helps preserve diversity
* Allowing areas to recover from farming and deforestation and allow natural succession to take place

IMPACT:

* Global warming (increased Carbon Dioxide) – hotter climates can cause speciation
* global dimming (increased atmospheric dust). Consequence is less light for photosynthesis so ultimately less glucose
* less photosynthesis = favour more shade-adapted species

BITS OF INFORMATION TO REMEMBER:

* With global warming – can cause anatomical adaptations, such as thick fur for insulation no longer being of benefit so these animals could die out
* GLOBAL WARMING – February 2016 was 1.35C warmer than 1980. In 2015 the annual rise of Co2 was 3.09 ppm, the highest record
* Less photosynthesis and favouring shade-adapted species – lead to plant species dying out, reducing diversity of producers so less food and also less habitats so change in food webs. This could lead to genetic bottlenecks that reduce the gene pool
* Example, loss of bamboo in China can reduce net productivity and oxygen release and also challenge the existence of Giant Panda.
* Conservation example – in Africa the conservation of the elephant population that was almost hunted into extinction will help to maintain the variety of the local habitat

**RECEPTORS, THEIR ROLE IN COORDINATION AND RESPONSE TO THE ENVIRONMENT**

* receptors = structures that detect specific stimuli and transduce their energy into nerve impulses as a form the body can interpret to allow the coordination of an appropriate response
* they can detect external stimuli and internal stimuli
* kinesis – woodlice
* taxis – plants
* eye – rod and cone
* Pacinian corpuscle
* Thermoreceptors
* chemoreceptors heart
* Baroreceptors in heart
* Glucose receptor
* Phagocytes – antigens
* Nervous impulse

BITS OF INFORMATION TO REMEMBER:

* Chemoreceptors are often proteins with a specific three dimensional shape that is complementary to a chemical stimulus
* Glucose receptors – increased glucose is detected by receptor on surface of beta-cell which triggers release of insulin which, in turn, travels to liver and binds to another receptor forming hormone-receptor complex which alters shape of receptor and triggers enzyme to condense glucose to glycogen in glycogenesis.
* Phagocytes – they circle in blood and have receptors on their surface that’re complementary to antigens on surface of pathogens. They bind and phagocytosis is initiated.
* Quantum dots can be used to stimulate damaged cells in the brain and eye which could help treat Alzheimers, depression and epilepsy as these brain disorders are caused by an imbalanced neural activity. Energy excites electrons within the quantum dot which causes the surrounding area to become negatively charged, generating action potentials.
* The most ancient nervous system preserved in fossils was 520 million years old and was more intricate than modern day insects.
* People with congenital analgesia cannot feel pain while people with EM (or “man-on-fire syndrome”) feel extreme pain. It’s been found they have a mutation in the gene coding for the Nav1.7 sodium channel so either the channel is hypersensitive or is non-functional and thus cannot interpret the pain signals. Drugs (such as the Pfizer drug) could be created to block this channel and this block pain (The pharmaceutical journal, march). Overall there are 9 different sodium channels.

**PATHWAYS OF SYNTHESIS OF CARBOHYDRATES FROM CARBON DIOXIDE**

* Carbohydrates = range of compounds containing carbon, hydrogen and oxygen
* Carbon cycle
* Photosynthesis synthesises carbohydrates
* Glucose; alpha and beta glucose
* Glucose can be condensed to starch

BITS OF INFORMATION TO REMEMBER:

* Carbon dioxide is a non-polar molecule and is hydrophobic so can diffuse directly into the cytoplasm of the cell and be transported to the chloroplast in readiness for its reduction to carbohydrate.
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**PROTEINS ARE MADE IN CELLS THAT ARE REMOTE FROM THEIR TARGET TISSUES. DESCRIBE HOW AN ANTI-INFLUENZA ANTIBODY IS SYNTHESISED AND EXERTS AN EFFECT ELSEWHERE**

* INFLUENZA – virus.
* T-CELLS AND B-CELLS
* ANTIBODIES – proteins released from plasma cells in response to antigens. They bind to antigens and render the pathogen inactive
* How an antibody is formed – transcription, vesicle, travel in blood pumped by heart

BITS OF INFORMATION TO REMEMBER:

* Influenza - Enters lungs by ventilation and enters epithelial cells. Enters nucleus and uses endonuclease enzymes to seal its DNA across that of the host. This alters the control and regulation of the cells. When DNA then replicates, the DNA of the virus is also replicated and this alters the shape of the antigens that are expressed on the surface of the cells. The damaged cells may release chemical mediators like prostaglandins or histamine to increase the permeability of the capillaries to white cells such as T-cells to coordinate the immune system.
* T-cells – white blood cells involved in cell mediated immunity that targets antigens that are non-host. They have receptors with a complementary shape to bind to antigens and recognise non-host cells. This activates t-cells to divide by mitosis to form either more memory cells, a T-killer cells or a T-helper cell that releases cytokines that activate B-cells.
* B-cells – involved in humoral immunity. Activated by T-helper cells and divide by mitosis to differentiate into B-memory and plasma cells (which can produce a specific antibody)
* Antibodies – Y shaped globular protein with a constant region and variable region that’s complementary to the target antigen. Secreted from differentiated B-cells called plasma cells.
* HOW TO FORM AN ANTIBODY – process of transcription and translation. Once the amino acid chain is formed, the protein is packaged into vesicles from the rough endoplasmic reticulum and transported to the Golgi apparatus where it is folded into the Y shape. The vesicles are pushed towards the B-cell’s membrane using energy from ATP so the antibody is released into blood plasma.
* Antibody then attaches to antigen forming a complex and attracting phagocytes.

**CRITICALLY ANALYSES THE METHODS USED TO COLLECT BIOLOGICAL DATA**

* Must be reliable, precise and accurate
* Quantitative data that tests can be performed on
* objective not subjective.
* Getting standard deviation
* All three statistical tests
* Sample size
* Problems quantifying habitats and ecosystems
* Mark-release-recapture
* Abundance, distribution using quadrats and transects
* Lab and equipment with precision
* Microscopes

BITS OF INFORMATION TO REMEMBER:

* Statistical tests usefulness is hampered by sample size and the way data was collected. If too few samples the statistical significance is impaired as it may happen by chance. however too big a sample is difficult to organise and handle data.
* Hard to quantify habitats and ecosystems as organisms are constantly growing and there is also emigration and immigration. So we can use mark-release-recapture. However, it is prone to errors caused by the high sampling size needed to get accuracy and seasonal changes can cause differences in data.
* Quadrats limited in the size of organism they can contain as shrubs and trees can’t fit inside.
* Measurements of dry biomass is limited for large trees are cannot fit into suitable oven for drying
* In lab there’s problems with human error in reading the measurements or timing and differences in precision of the measurement tools
* Light microscope – not high enough resolution to view detail inside of cells.
* Electron microscope – expensive, sample must be non-living and very thin.

**RISING TEMPERATURES CAN RESULT IN PHYSIOLOGICAL AND ECOLOGICAL EFFECTS ON LIVING ORGANISMS. DESCRIBE AND EXPLAIN THESE EFFECTS**

* Explain global warming

BACTERIA:

* Microbes respire more so grow more and pathogens spread
* Decomposers lead further to carbon cycle releasing carbon dioxide

SINGLE CELLED PHOTOSYNTHETIC ALGAE:

* Growth rates increased = algal bloom = eutrophication, this can reduce diversity and destabilise food webs

PLANTS:

* Increased transpiration which would, over time, force xerophytic adaptions by natural selection (reduced surface area to volume ratio, rolled leaves, sunken stomata)
* These changes reduce biodiversity and reduce productivity so fewer habitats and food for animals, leading to genetic bottlenecks (large reduction in population reduces range of alleles). Surviving population more prone to extinction

ENDOTHERMIC ANIMALS:

* Thermoreceptors cause sweating, vasodilation etc.
* Selection pressures for less body hair and leaner bodies with higher surface area to volume ratio to dissipate heat more effectively.
* Alter position of oxygen dissociation curve of haemoglobin to the left (less oxygen unloaded due to increased affinity since respiration reduced)

ECTOTHERMIC REPTILES:

* Behavioural adaptation.

BITS OF INFORMATION TO REMEMBER:

* The effects can lead to changes in the metabolic processes inside organisms and over time can force adaptation and natural selection

Microorganisms like bacteria and fungi:

* No homeostatic mechanisms to control body temp so will have big impact on metabolism. Enzyme controlled activities increase so increased respiration = they can replicate more quickly as more ATP is available for growth.
* Pathogens will increase in growth rate, also increasing the mutation rate, possibly leading to the production of more pathogenic forms. Some will be able to evade the host immune system, increasing disease.
* Microbes act as decomposers. These microbes will increase decomposition rates and carbon & nitrogen cycling, further releasing carbon dioxide and adding to global warming.

Plants:

* Evaporation of water from the mesophyll cells through the stomata creates a water potential gradient (a tension) that draws water up the xylem. Water molecules have hydrogen bonds between them (cohesion) which draws water up.

**THE DIFFERENT WAYS IN WHICH ORGANISMS USE INORGANIC IONS**

* Inorganic ions = charged particles that do not contain carbon atoms bonded together, such as nitrate, hydrogen, calcium and iron
* NITROGEN helping productivity and plant growth
* Photosynthesis needs water – water brought up stem by mineral ions being transported from soil into root hair cells to lower the water potential
* Photosynthesis uses hydrogen ions which reduce NADP
* Respiration – hydrogen ions used to produce ATP in the electron transport chain.
* Nerve impulse – resting potential maintained by pumping 3 sodium out for 2 potassium in
* Muscles – calcium ions
* Iron – haemoglobin

BITS OF INFORMATION TO REMEMBER:

* NITROGEN – nitrogen fixing bacteria in roots reduce atmospheric nitrogen to ammonium ions. The ammonium ions are then oxidised by nitrifying bacteria to nitrites then nitrates and this increases the nitrogen content in the soil that plants use to produce molecules like amino acids, proteins, DNA and ATP.
* Respiration – hydrogen ions are pumped into inter-membrane space to generate an electrochemical gradient that provides energy to activate ATPase.
* Muscle contraction is also used by animals in processes such as controlling light energy into the eye and blood flow in arterioles in the maintenance of homeostasis
* Iron – 3 iron ions attached to haem groups. The iron can form bonds to oxygen, allowing haemoglobin o load oxygen in the lungs when the partial pressure of oxygen is high.

**CONDENSATION AND HYDROLYSIS AND THEIR IMPORTANCE IN BIOLOGY**

* HYDROLYSIS: (large molecule split into smaller ones, breaking a bond and taking in water)
* Hydrolysis of ATP - the ATP can then be used for muscle contraction
* Hydrolysis of glucose into starch/cellulose
* Digestive enzymes and the hydrolysis into macromolecules
* Glucose levels can be kept constant by hydrolysis of glycogen or condensation of glucose
* Recycling of nutrients enabled due to bacteria hydrolysing molecules into smaller ones.
* CONDENSATION: (2 molecules joined to make one larger one, with the loss of water)
* DNA polymerase joins nucleotides via condensation during DNA replication
* Condensation of amino acids into polypeptides/proteins
* Lipids – glycerol and 3 fatty acids linked with an ester bond
* PHOTOSYNTHESIS – Aphids may be the first photosynthesising organisms. They increase ATP in response to light, hinting that they might photosynthesise. Carotenoids are common in plants to harvest light and Aphids are the only insects with the genes to produce carotenoids

**FACTORS WHICH DETERMINE AN ORGANISMS PHENOTYPE**

* ENVIRONMENTAL:
* Diet - diabetes
* Smoking
* Selection
* GENETICS:
* Random fusion of gametes
* Crossover of chromosomes
* mutations
* Alleles inherited from parents combination of alleles

**RELATIONSHIPS BETWEEN PLANTS AND ANIMALS**

* A symbiotic relationship - both are dependent on each other.
* Plants give off oxygen which the animals intake and the animals give off carbon dioxide, which the plants need.
* Nitrogen cycle
* Carbon cycle
* Farming – income
* PHOTOSYNTHESIS – Aphids may be the first photosynthesising organisms. They increase ATP in response to light, hinting that they might photosynthesise. Carotenoids are common in plants to harvest light and Aphids are the only insects with the genes to produce carotenoids

**ROLE OF WATER IN LIVING ORGANISMS**

* Water is a universal solvent. It dissolves substances and is present in blood to allow digested substances like glucose to be carried along to respiring cells
* Allows toxic material like urea to be dissolved so it does not harm the organism
* Needed in homeostasis – sweat
* Used in photosynthesis
* Transpiration
* Osmosis and plant cell turgid
* Transparent – allows water through for aquatic organisms
* Water vapour can act as a greenhouse gas
* PHOTOSYNTHESIS – Aphids may be the first photosynthesising organisms. They increase ATP in response to light, hinting that they might photosynthesise. Carotenoids are common in plants to harvest light and Aphids are the only insects with the genes to produce carotenoids

**TREATING DISEASE**

* Treating diabetes – insulin injections - . New hormone, Asporosin, can help treat type 2 diabetes. It is released by fat cells and goes to the liver, telling it to release glucose. When glucose levels rise, production of Asporosin is switched off. A study has shown that treating diabetic mice with asprosin-blocking antibodies seems to be working
* **C**ystic fibrosis
* SCID (severe combined immunodeficiency disorder) Gene therapy can help SCID by Strim velis – extract bone marrow stem cells that regenerate the immune system and infect them with a harmless virus that uploads a correct copy of the gene for ASA. The altered cells are injected back into the patient where they generate a healthy immune system
* Germ-line therapy, somatic cell-therapy, wrapping in lipid
* Cancer
* Less exposure to mutagenic agents
* Genetic screening
* Stem cells grown in vitro and induced to develop into different cells
* Stem cells – heart cells to treat heart damage, skeletal muscle cells to treat muscular dystrophy, beta cells of pancreas to treat diabetes II, nerve cells to treat Parkinson’s, blood cells to treat leukaemia, skin cells to treat wounds, bone cells for osteoporosis, cartilage cells for osteoarthritis, retina cells for macular degeneration.
* Gene therapy for cyctic fibrosis showed 3.7% better lung functioning
* Stem cells – scientists have developed a new kind of stem cells with only one set of chromosomes, but it can still turn into any human cells. This has applications in genetic screening
* NANOBOTS – nano-sized entities of DNA can deliver drugs in living cockroaches. They travel around and when they interact with certain cells they uncurl and release the drugs they’re carrying in their folds. We can progress this to humans by creating nanobots with certain base sequences that uncurl when contacting specific diseased cells.
* Quantum dots can be used to stimulate damaged cells in the brain and eye which could help treat Alzheimer’s, depression and epilepsy as these brain disorders are caused by an imbalanced neural activity. Energy excites electrons within the quantum dot which causes the surrounding area to become negatively charged, generating action potentials.
* PPI drugs have also been found to help Alzheimer’s (the pharmaceutical journal)

**DIFFUSION AND OSMOSIS**

* Types of diffusion
* Gas exchange in humans, fish, insects
* Digestion and absorption of products
* Exchange of material between blood and capillaries
* Ions uptake by roots
* Kidney
* Synaptic transmission
* Muscle action
* Osmosis and turgidity of plant cells
* Osmosis and cystic fibrosis

**MAINTAINING CONSTANT INTERNAL ENVIRONMENTS**

* Blood
* Body temperature
* Glucose
* Regulation of sex hormones by negative feedback

**NEGATIVE FEEDBACK**

* departure from a norm initiates changes which restore a system to the norm.
* importance in homeostasis; principles of detection of change, role of receptors, corrective response, role of effectors.
* Thermoregulation and thermoreceptors; heat loss and heat gain centres
* Regulation of blood glucose
* Control of ventilation - stimulation of chemoreceptors in medulla, effect on inspiration, stimulation of stretch receptors in lungs, stimulation of expiratory cells in medulla.
* Control of heartbeat
* Metabolic pathways - examples of build-up of a product in a metabolic pathway resulting in inhibition of its formation.
* Population stability - effect of increasing competition/predation on increasing population size and restoration of balance. (stabilising selection resulting in constancy of species
* Oestrous cycle - feedback on hormone production, e.g. oestrogen on FSH and progesterone on both FSH and LH.