GCSE Edexcel Triple Biology

Topic 1 – Key concepts in biology

1.1 Explain how the sub-cellular structures of eukaryotic and prokaryotic cells are related to their functions, including animal cells, plant cells and bacteria

1. What is the function of the nucleus in a eukaryotic cell?
2. What is the function of mitochondria in animal and plant cells?
3. What is the function of ribosomes in animal, plant and bacterial cells?
4. What are the functions of chloroplasts and the permanent vacuole in plant cells?
5. What is the function of the cell wall in plant cells?
6. What are the functions of chromosomal DNA, plasmid DNA, the cell membrane and flagella in bacterial cells?

1.2 Describe how specialised cells are adapted to their function, including sperm cells, egg cells and ciliated epithelial cells

1. How is the acrosome of a sperm cell adapted for fertilisation?
2. How are the mitochondria of a sperm cell adapted for its function?
3. Why is the nucleus of a sperm cell haploid?
4. How are the nutrients in the cytoplasm of an egg cell adapted for its function?
5. What happens to the egg cell membrane after fertilisation, and why?
6. How are ciliated epithelial cells adapted to move mucus and trapped particles?

1.3 Explain how changes in microscope technology, including electron microscopy, have enabled us to see cell structures and organelles with more clarity and detail than in the past and increased our understanding of the role of sub-cellular structures

1. Why did improvements in microscope technology allow scientists to observe more detailed cell structures?
2. Why can electron microscopes show smaller structures than light microscopes?
3. What is meant by the resolution of a microscope?

4. How does increased resolution improve the ability to distinguish between two closely positioned structures?
5. Why would an electron microscope be more suitable than a light microscope for studying the ultrastructure of mitochondria?
6. How have advances in microscopy increased understanding of the functions of sub-cellular structures?

1.4 Demonstrate an understanding of number, size and scale, including the use of estimations and explain when they should be used

1. What is meant by an estimate?
2. Why are estimates useful when an exact measurement is difficult or unnecessary?
3. What is meant by the order of magnitude of a measurement?
4. How can an object's known size be used to estimate the size of another object?
5. Why is it important to consider scale when studying structures such as cells and organelles?
6. When would an estimate be more appropriate than an exact measurement in biology?

1.5 Demonstrate an understanding of the relationship between quantitative units in relation to cells, including milli, micro, nano, pico and calculations with numbers written in standard form

1. What multiplier does the prefix milli represent?
2. What multiplier does the prefix micro represent?
3. What multiplier does the prefix nano represent?
4. What multiplier does the prefix pico represent?
5. How many micrometres are there in 0.000004 metres?
6. What is the result of calculating $(3 \times 10^{-6}) \times (2 \times 10^{3})$, expressed in standard form?

1.6 Core Practical: Investigate biological specimens using microscopes, including magnification calculations and labelled scientific drawings from observations

1. What equation is used to calculate microscope magnification?
2. What is the magnification of a specimen with an actual size of 50 µm and an image size of 10 mm?
3. What is the actual size of a cell with an image size of 8 mm viewed at ×400 magnification?
4. What features should be included in a labelled scientific drawing of a biological specimen?
5. Why should biological drawings use clear, single lines rather than shading?

6. Why must measurements be converted into the same units before calculating microscope magnification?

1.7 Explain the mechanism of enzyme action including the active site and enzyme specificity

1. What is an enzyme?
2. What is the active site of an enzyme?
3. What is meant by the specificity of an enzyme?
4. Why can a substrate bind to the active site of one enzyme but not another enzyme?
5. What happens when a substrate binds to the active site of an enzyme?
6. How does the shape of an enzyme's active site determine which substrate it can bind to?

1.8 Explain how enzymes can be denatured due to changes in the shape of the active site

1. What does it mean when an enzyme is denatured?
2. How can a high temperature change the shape of an enzyme's active site?
3. Why does changing the shape of an enzyme's active site reduce enzyme activity?
4. Why can a denatured enzyme no longer bind effectively to its substrate?
5. How can an extreme pH change the shape of an enzyme's active site?
6. Why is enzyme denaturation usually permanent?

1.9 Explain the effects of temperature, substrate concentration and pH on enzyme activity

1. Why does increasing temperature initially increase the rate of an enzyme-controlled reaction?
2. Why does enzyme activity decrease rapidly above the optimum temperature?
3. How does increasing substrate concentration affect enzyme activity when enzyme concentration remains constant?
4. Why does enzyme activity eventually stop increasing when substrate concentration continues to increase?
5. Why does each enzyme have an optimum pH?
6. What happens to enzyme activity when the pH moves substantially away from its optimum?

1.10 Core Practical: Investigate the effect of pH on enzyme activity

1. What is the independent variable when investigating the effect of pH on enzyme activity?
2. What measurement can be used to determine the rate of an enzyme-controlled reaction?
3. Why should temperature be kept constant when investigating the effect of pH on enzyme activity?
4. Why should the concentration of enzyme be kept constant when investigating the effect of pH on enzyme activity?
5. Why should the concentration of substrate be kept constant when investigating the effect of pH on enzyme activity?
6. How can experimental results be used to determine the optimum pH of an enzyme?

1.11 Demonstrate an understanding of rate calculations for enzyme activity

1. What equation is used to calculate the rate of an enzyme-controlled reaction?
2. What is the rate of an enzyme reaction that produces 24 cm^3 of product in 6 minutes?
3. What is the rate of an enzyme reaction that breaks down 40 mg of substrate in 8 minutes?
4. How long does an enzyme reaction take to produce 15 cm^3 of product at a rate of 3 cm^3/min?
5. What is the rate of an enzyme reaction that produces 10 cm^3 of product in 20 seconds?
6. Why is reaction rate useful when comparing enzyme activity under different conditions?

1.12 Explain the importance of enzymes as biological catalysts in the synthesis of carbohydrates, proteins and lipids and their breakdown into sugars, amino acids and fatty acids and glycerol

1. What is the role of enzymes as biological catalysts?
2. What smaller molecules are produced when carbohydrates are broken down by enzymes?
3. What smaller molecules are produced when proteins are broken down by enzymes?
4. What smaller molecules are produced when lipids are broken down by enzymes?
5. Why are enzymes needed to synthesise larger biological molecules from smaller molecules?
6. Why are enzymes important for the breakdown of large biological molecules during digestion?

1.13B Core Practical: Investigate the use of chemical reagents to identify starch, reducing sugars, proteins and fats

1. Which chemical reagent is used to test for starch?
2. What colour change indicates a positive test for starch using iodine solution?
3. Which chemical reagent is used to test for reducing sugars?
4. What colour change indicates a positive Benedict's test for reducing sugars after heating?
5. Which chemical reagent is used to test for proteins, and what positive result does it produce?
6. Which chemical reagent is used to test for fats, and what positive result does it produce?

1.14B Explain how the energy contained in food can be measured using calorimetry

1. What is calorimetry used to measure in a food investigation?
2. How does burning food transfer energy to water during calorimetry?
3. What measurements are needed to calculate the energy transferred to water during calorimetry?
4. What equation is used to calculate the energy transferred to water during calorimetry?
5. How can the energy transferred per gram of food be calculated in a calorimetry experiment?
6. Why does heat loss to the surroundings reduce the accuracy of food calorimetry results?

1.15 Explain how substances are transported into and out of cells, including by diffusion, osmosis and active transport

1. What is diffusion?
2. In which direction does a substance move during diffusion?
3. What is osmosis?
4. In which direction does water move during osmosis?
5. What is active transport?
6. Why does active transport require energy from respiration?

1.16 Core Practical: Investigate osmosis in potatoes

1. What is the independent variable when investigating the effect of solution concentration on potato mass?
2. Why should potato cylinders be cut to the same dimensions in an osmosis investigation?

3. Why should potato cylinders be blotted dry before their final mass is measured?
4. What happens to the mass of a potato cylinder placed in a solution with a lower solute concentration than the potato cells?
5. What happens to the mass of a potato cylinder placed in a solution with a higher solute concentration than the potato cells?
6. How can potato mass-change results be used to estimate the concentration of the potato cell sap?

1.17 Calculate percentage gain and loss of mass in osmosis

1. What equation is used to calculate percentage change in mass?
2. What is the percentage gain in mass when a potato cylinder increases from 5.0 g to 6.0 g?
3. What is the percentage loss in mass when a potato cylinder decreases from 8.0 g to 6.0 g?
4. What is the percentage change in mass when a potato cylinder increases from 4.0 g to 4.8 g?
5. What is the percentage change in mass when a potato cylinder decreases from 10.0 g to 7.5 g?
6. Why is percentage change in mass useful when comparing osmosis results from potato cylinders with different starting masses?

Topic 2 – Cells and control

2.1 Describe mitosis as part of the cell cycle, including the stages interphase, prophase, metaphase, anaphase and telophase and cytokinesis

1. What happens to the DNA during interphase of the cell cycle?
2. What happens to the chromosomes during prophase of mitosis?
3. What happens to the chromosomes during metaphase of mitosis?
4. What happens to the chromosomes during anaphase of mitosis?
5. What happens to the chromosomes during telophase of mitosis?
6. What is cytokinesis, and when does it occur during the cell cycle?

2.2 Describe the importance of mitosis in growth, repair and asexual reproduction

1. How does mitosis allow an organism to grow?
2. How does mitosis replace damaged cells during tissue repair?
3. Why is mitosis important for replacing old or worn-out cells?
4. Why is mitosis involved in asexual reproduction?

5. Why does asexual reproduction by mitosis produce genetically identical offspring?
6. Which type of cell division is responsible for growth and tissue repair in multicellular organisms?

2.3 Describe the division of a cell by mitosis as the production of two daughter cells, each with identical sets of chromosomes in the nucleus to the parent cell, and that this results in the formation of two genetically identical diploid body cells

1. How many daughter cells are produced by mitosis?
2. How does the chromosome number of each daughter cell compare with the parent cell after mitosis?
3. Why are the daughter cells produced by mitosis genetically identical to the parent cell?
4. What type of cells are produced by mitosis: haploid or diploid cells?
5. How does the genetic information in the nuclei of the two daughter cells compare with each other after mitosis?
6. Why must DNA be replicated before mitosis occurs?

2.4 Describe cancer as the result of changes in cells that lead to uncontrolled cell division

1. What is cancer?
2. What happens to cell division when a cell becomes cancerous?
3. How can changes in cells lead to uncontrolled cell division?
4. Why can uncontrolled cell division result in the formation of a tumour?
5. How does uncontrolled cell division differ from normal cell division?
6. Why can cancerous cells damage surrounding tissues?

2.5 Describe growth in organisms, including cell division and differentiation in animals and cell division, elongation and differentiation in plants

1. How does cell division contribute to growth in animals?
2. What is cell differentiation?
3. How does cell differentiation contribute to growth in animals?
4. How does cell division contribute to growth in plants?
5. How does cell elongation contribute to growth in plants?
6. How does cell differentiation contribute to growth in plants?

2.6 Explain the importance of cell differentiation in the development of specialised cells

1. What is cell differentiation?

2. Why is cell differentiation important in multicellular organisms?
3. How does differentiation allow cells to become specialised?
4. Why do specialised cells have structures adapted to particular functions?
5. How does cell differentiation contribute to the formation of different tissues?
6. Why cannot a multicellular organism function effectively if all of its cells remain unspecialised?

2.7 Demonstrate an understanding of the use of percentiles charts to monitor growth

1. What is a percentile chart used for in biology?
2. How can a child's height be monitored using a percentile chart?
3. What does it mean if a child's height is on the 50th percentile?
4. What does a change in a child's position across percentile lines indicate?
5. Why can percentile charts be used to identify unusual patterns of growth?
6. Why should a person's growth be monitored over time rather than using a single measurement?

2.8 Describe the function of embryonic stem cells, stem cells in animals and meristems in plants

1. What is an embryonic stem cell?
2. Why can embryonic stem cells differentiate into many different cell types?
3. What is the function of stem cells in adult animals?
4. Where are meristem cells found in plants?
5. What is the function of meristem cells in plants?
6. How do meristem cells contribute to plant growth?

2.9 Discuss the potential benefits and risks associated with the use of stem cells in medicine

1. How could stem cells be used to replace damaged or diseased cells?
2. How could stem cells potentially help treat paralysis or damage to nervous tissue?
3. How could stem cells potentially be used to treat diseases such as diabetes?
4. What is one risk associated with using stem cells in medicine?
5. Why could uncontrolled stem cell division increase the risk of tumour formation?
6. Why are embryonic stem cells considered ethically controversial?

2.10B Describe the structures and functions of the brain including the cerebellum, cerebral hemispheres and medulla oblongata

1. What is the function of the cerebellum?
2. What is the function of the cerebral hemispheres?
3. What is the function of the medulla oblongata?
4. Which part of the brain is responsible for coordinating movement and balance?
5. Which part of the brain is responsible for conscious thought, memory and intelligence?
6. Which part of the brain controls involuntary activities such as breathing and heart rate?

2.11B Explain how the difficulties of accessing brain tissue inside the skull can be overcome by using CT scanning and PET scanning to investigate brain function

1. Why is it difficult to investigate brain tissue directly?
2. What does a CT scan allow scientists and doctors to examine inside the skull?
3. How does a CT scan produce an image of the brain?
4. What does a PET scan allow scientists to investigate in the brain?
5. How does a PET scan show which areas of the brain are active?
6. Why are CT and PET scans useful alternatives to directly accessing brain tissue?

2.12B Explain some of the limitations in treating damage and disease in the brain and other parts of the nervous system, including spinal injuries and brain tumours

1. Why is damage to the brain difficult to treat?
2. Why can damage to the spinal cord cause long-term loss of movement or sensation?
3. Why can brain tumours be difficult to treat surgically?
4. Why can surgery on the brain damage healthy nervous tissue?
5. Why can damage to neurones be difficult to repair?
6. Why are treatments for brain tumours limited by the location of the tumour?

2.13 Explain the structure and function of sensory receptors, sensory neurones, relay neurones in the CNS, motor neurones and synapses in the transmission of electrical impulses, including the axon, dendron, myelin sheath and the role of neurotransmitters

1. What is the function of a sensory receptor?
2. What is the function of a sensory neurone?
3. What is the function of a relay neurone in the central nervous system?
4. What is the function of a motor neurone?

5. What is the function of the myelin sheath around an axon?
6. How do neurotransmitters transmit a signal across a synapse?

2.14 Explain the structure and function of a reflex arc including sensory, relay and motor neurones

1. What is a reflex action?
2. What is the correct pathway of a reflex arc from a receptor to an effector?
3. What is the role of a sensory neurone in a reflex arc?
4. What is the role of a relay neurone in a reflex arc?
5. What is the role of a motor neurone in a reflex arc?
6. Why are reflex actions rapid and automatic?

2.15B Explain the structure and function of the eye as a sensory receptor including the role of the cornea and lens, the iris, and rod and cone cells in the retina

1. What is the function of the cornea in the eye?
2. What is the function of the lens in the eye?
3. What is the function of the iris?
4. What is the function of rod cells in the retina?
5. What is the function of cone cells in the retina?
6. How do rod and cone cells allow the eye to detect light and colour?

2.16B Describe defects of the eye including cataracts, long-sightedness, short-sightedness and colour blindness

1. What is a cataract?
2. How does a cataract affect vision?
3. What is long-sightedness?
4. What is short-sightedness?
5. What is colour blindness?
6. Why does colour blindness affect a person's ability to distinguish certain colours?

2.17B Explain how cataracts, long-sightedness and short-sightedness can be corrected

1. How can cataracts be treated to restore clear vision?
2. How do convex lenses correct long-sightedness?
3. How do concave lenses correct short-sightedness?
4. Why does a convex lens help focus light onto the retina in a long-sighted eye?

5. Why does a concave lens help focus light onto the retina in a short-sighted eye?
6. Where should light be focused for a person to see a clear image?

Topic 3 – Genetics

3.1B Explain some of the advantages and disadvantages of asexual reproduction, including the lack of need to find a mate, a rapid reproductive cycle, but no variation in the population

1. What is asexual reproduction?
2. Why does asexual reproduction not require an organism to find a mate?
3. Why can asexual reproduction produce offspring rapidly?
4. Why are offspring produced by asexual reproduction genetically very similar to the parent?
5. What is a disadvantage of having little or no genetic variation in a population?
6. What is one advantage and one disadvantage of asexual reproduction?

3.2B Explain some of the advantages and disadvantages of sexual reproduction, including variation in the population, but the requirement to find a mate

1. What is sexual reproduction?
2. Why does sexual reproduction produce genetic variation in offspring?
3. Why can genetic variation increase a population's ability to survive environmental changes?
4. Why does sexual reproduction usually require organisms to find a mate?
5. Why can sexual reproduction be slower than asexual reproduction?
6. What is one advantage and one disadvantage of sexual reproduction?

3.3 Explain the role of meiotic cell division, including the production of four daughter cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes

1. What is the role of meiosis in sexual reproduction?
2. How many daughter cells are produced by meiosis?
3. How does the chromosome number of a meiotic daughter cell compare with the original cell?
4. What is the chromosome number of a human gamete compared with a human body cell?
5. Why are the gametes produced by meiosis genetically different from each other?
6. What type of cells are produced by meiosis: haploid or diploid cells?

3.4 Describe DNA as a polymer made up of two strands coiled to form a double helix, complementary base pairs joined by weak hydrogen bonds, and nucleotides consisting of a sugar, phosphate group and base

1. What shape does a DNA molecule have?
2. What holds the two strands of a DNA molecule together?
3. Which four bases are found in DNA?
4. Which bases are complementary in DNA?
5. What three components make up a DNA nucleotide?
6. How are nucleotides joined together to form a DNA strand?

3.5 Describe the genome as the entire DNA of an organism and a gene as a section of a DNA molecule that codes for a specific protein

1. What is a genome?
2. What is a gene?
3. How is a gene related to the production of a protein?
4. How does the genome differ from a single gene?
5. Where is genetic information stored in a cell?
6. Why can different genes code for different proteins?

3.6 Explain how DNA can be extracted from fruit

1. Why is detergent used when extracting DNA from fruit?
2. Why is salt added during a fruit DNA extraction?
3. Why is the fruit mashed or blended during DNA extraction?
4. What is the purpose of filtering the fruit mixture during DNA extraction?
5. Why is cold ethanol or ice-cold alcohol added during DNA extraction?
6. What appearance does the extracted DNA usually have?

3.7B Explain how the order of bases in a section of DNA decides the order of amino acids in the protein and that these fold to produce specifically shaped proteins such as enzymes

1. How does the base sequence of a gene determine the amino acid sequence of a protein?
2. What is the relationship between the sequence of amino acids and the shape of a protein?
3. Why does changing the base sequence of a gene potentially change the protein produced?
4. Why is the specific shape of an enzyme important for its function?
5. How can the amino acid sequence determine the shape of an enzyme?
6. Why can a change in DNA sometimes affect the function of a protein?

3.8B Describe the stages of protein synthesis, including transcription and translation

1. What is transcription in protein synthesis?
2. What is the role of RNA polymerase during transcription?
3. What is produced when RNA polymerase transcribes a gene?
4. Where does mRNA attach during translation?
5. What is the role of codons in protein synthesis?
6. What is the role of tRNA in protein synthesis?

3.9B Describe how genetic variants in the non-coding DNA of a gene can affect phenotype by influencing the binding of RNA polymerase and altering the quantity of protein produced

1. What is non-coding DNA?
2. How can a genetic variant in non-coding DNA affect the binding of RNA polymerase?
3. How can altered RNA polymerase binding affect transcription?
4. How can a genetic variant in non-coding DNA alter the quantity of protein produced?
5. Why can changing the amount of a protein affect an organism's phenotype?
6. How can a genetic variant affect phenotype without changing the amino acid sequence of a protein?

3.10B Describe how genetic variants in the coding DNA of a gene can affect phenotype by altering the sequence of amino acids and therefore the activity of the protein produced

1. What is coding DNA?
2. How can a genetic variant in coding DNA change the amino acid sequence of a protein?
3. How can changing the amino acid sequence affect the shape of a protein?
4. How can a change in protein shape affect its activity?
5. Why can a genetic variant in coding DNA cause a change in phenotype?
6. How could a mutation in the coding DNA of an enzyme affect the enzyme's activity?

3.11B Describe the work of Gregor Mendel in discovering the basis of genetics and recognise the difficulties of understanding inheritance before the mechanism was discovered

1. What organism did Gregor Mendel use to investigate inheritance?

2. What did Mendel's experiments demonstrate about the inheritance of characteristics?
3. Why were pea plants useful for Mendel's genetic experiments?
4. Why was inheritance difficult to understand before Mendel's work?
5. Why did Mendel's work provide evidence that characteristics are inherited as discrete factors?
6. Why was Mendel's work not fully appreciated when it was first published?

3.12 Explain why there are differences in the inherited characteristics as a result of alleles

1. What is an allele?
2. Why can different alleles of the same gene produce different inherited characteristics?
3. How can an individual inherit different alleles of the same gene?
4. Why can siblings have different inherited characteristics?
5. How does sexual reproduction contribute to differences in inherited characteristics?
6. How can different combinations of alleles produce different phenotypes?

3.13 Explain the terms chromosome, gene, allele, dominant, recessive, homozygous, heterozygous, genotype, phenotype, gamete and zygote

1. What is a chromosome?
2. What is a gene?
3. What is an allele?
4. What is the difference between a dominant allele and a recessive allele?
5. What is the difference between a homozygous genotype and a heterozygous genotype?
6. What are the meanings of genotype, phenotype, gamete and zygote?

3.14 Explain monohybrid inheritance using genetic diagrams, Punnett squares and family pedigrees

1. What is a monohybrid cross?
2. What information does a Punnett square show?
3. How can a genetic diagram be used to predict the genotypes of offspring?
4. How can a genetic diagram be used to predict the phenotypes of offspring?
5. What symbols are commonly used to represent dominant and recessive alleles in a genetic diagram?
6. What information can a family pedigree show about the inheritance of a characteristic?

3.15 Describe how the sex of offspring is determined at fertilisation, using genetic diagrams

1. Which sex chromosomes does a human female normally have?
2. Which sex chromosomes does a human male normally have?
3. Which sex chromosome can a human egg cell carry?
4. Which sex chromosome can a human sperm cell carry?
5. How does fertilisation determine the sex chromosome combination of a human offspring?
6. What is the probability of a human child being genetically male or genetically female?

3.16 Calculate and analyse outcomes using probabilities, ratios and percentages from monohybrid crosses and pedigree analysis for dominant and recessive traits

1. What is the probability of an offspring inheriting a particular genotype from a given Punnett square?
2. How can a Punnett square be used to calculate the expected percentage of offspring with a particular phenotype?
3. What phenotypic ratio is expected from a heterozygous dominant × heterozygous dominant monohybrid cross?
4. What genotypic ratio is expected from a heterozygous × heterozygous monohybrid cross?
5. What percentage of offspring are expected to show a recessive phenotype from Aa × Aa?
6. How can a pedigree be used to determine whether a characteristic is likely to be dominant or recessive?

3.17B Describe the inheritance of the ABO blood groups with reference to codominance and multiple alleles

1. What are the three alleles that determine the ABO blood group system?
2. What does it mean that the ABO blood group system has multiple alleles?
3. Which ABO alleles are codominant?
4. What blood group results from the genotype I^AI^B?
5. What blood group results from the genotype I^Ai?
6. What blood group results from the genotype ii?

3.18B Explain how sex-linked genetic disorders are inherited

1. What is a sex-linked genetic disorder?
2. Why are X-linked recessive disorders more common in males than females?
3. Why can a male inherit an X-linked disorder from his mother?

4. Why can a female be a carrier of an X-linked recessive disorder without showing the disorder?
5. How can a carrier mother and an unaffected father have a son with an X-linked recessive disorder?
6. Why cannot a father pass an X-linked allele directly to his son?

3.19 State that most phenotypic features are the result of multiple genes rather than single gene inheritance

1. What does it mean when a characteristic is controlled by multiple genes?
2. Why are most human phenotypic features not controlled by a single gene?
3. Give one example of a human characteristic influenced by multiple genes.
4. Why can characteristics controlled by many genes show a wide range of phenotypes?
5. How can multiple genes contribute to variation in human height?
6. How does polygenic inheritance differ from single-gene inheritance?

3.20 Describe the causes of variation that influence phenotype, including genetic and environmental variation

1. What is genetic variation?
2. How can mutations cause genetic variation?
3. How does sexual reproduction produce genetic variation?
4. What is environmental variation?
5. How can an organism's environment affect its phenotype?
6. What is an example of a characteristic influenced by both genetic and environmental factors?

3.21 Discuss the outcomes of the Human Genome Project and its potential applications within medicine

1. What was the main aim of the Human Genome Project?
2. What information did the Human Genome Project provide about human DNA?
3. How could knowledge of the human genome help identify genes associated with inherited diseases?
4. How could genome information be used to improve the diagnosis of genetic disorders?
5. How could knowledge of a person's genome contribute to personalised medicine?
6. What is one potential ethical concern associated with the use of human genome information?

3.22 State that there is usually extensive genetic variation within a population of a species and that these arise through mutations

1. What is genetic variation within a population?
2. What is a mutation?
3. How can mutations create new alleles?
4. Why can mutations increase genetic variation within a population?
5. Why does sexual reproduction help produce genetic variation in a population?
6. Why is genetic variation important for the survival of a species when environments change?

3.23 State that most genetic mutations have no effect on the phenotype, some mutations have a small effect on the phenotype and, rarely, a single mutation will significantly affect the phenotype

1. Why do most genetic mutations have no effect on phenotype?
2. Why can some genetic mutations have a small effect on phenotype?
3. Why can a single mutation rarely have a large effect on phenotype?
4. How can a mutation in a gene affect the protein produced?
5. Why might a mutation that changes a protein's function significantly affect phenotype?
6. Why is the effect of a mutation dependent on the gene and DNA sequence affected?

Topic 4 – Natural selection and genetic modification

4.1B Describe the work of Charles Darwin and Alfred Wallace in the development of the theory of evolution by natural selection and explain the impact of these ideas on modern biology

1. What did Charles Darwin contribute to the development of the theory of evolution by natural selection?
2. What did Alfred Wallace contribute to the development of the theory of evolution by natural selection?
3. What observations helped Darwin develop his theory of natural selection?
4. Why is Darwin's theory of natural selection important to modern biology?
5. How did Darwin and Wallace independently contribute to the theory of evolution?
6. How did the theory of natural selection change scientific understanding of how species change over time?

4.2 Explain Charles Darwin's theory of evolution by natural selection

1. What is natural selection?
2. Why is there variation between individuals in a population?
3. Why do organisms with advantageous characteristics have a greater chance of surviving and reproducing?
4. How are advantageous alleles passed to future generations?
5. How can natural selection cause a characteristic to become more common in a population over many generations?
6. How can natural selection eventually lead to the evolution of a new species?

4.3 Explain how the emergence of resistant organisms supports Charles Darwin's theory of evolution including antibiotic resistance in bacteria

1. How can antibiotic resistance arise in a bacterial population?
2. Why does an antibiotic kill susceptible bacteria but not bacteria with a resistance allele?
3. How does antibiotic use create a selection pressure on bacterial populations?
4. How can antibiotic-resistant bacteria become more common over successive generations?
5. Why does antibiotic resistance provide evidence supporting Darwin's theory of natural selection?
6. Why should antibiotics not be used unnecessarily?

4.4 Describe the evidence for human evolution, based on fossils, including Ardi, Lucy and Richard Leakey's discoveries

1. What is a fossil?
2. What does the 4.4-million-year-old Ardi fossil provide evidence about?
3. What does the 3.2-million-year-old Lucy fossil provide evidence about?
4. What did Richard Leakey's discovery of 1.6-million-year-old fossils contribute to our understanding of human evolution?
5. How can differences between fossils from different time periods provide evidence for human evolution?
6. Why does the fossil record provide evidence that humans have changed over time?

4.5 Describe the evidence for human evolution based on stone tools

1. How does the development of stone tools provide evidence for human evolution?
2. How have stone tools changed over time?
3. What can increasingly complex stone tools suggest about changes in human ancestors?

4. How can scientists determine the age of a stone tool from its environment?
5. Why can the position of a stone tool within different rock layers provide information about its age?
6. How can dating evidence from stone tools help scientists investigate human evolution?

4.6B Describe how the anatomy of the pentadactyl limb provides scientists with evidence for evolution

1. What is a pentadactyl limb?
2. What basic bone pattern is shared by pentadactyl limbs?
3. Which types of vertebrates have pentadactyl limbs?
4. Why does the similar underlying structure of pentadactyl limbs provide evidence for common ancestry?
5. How can pentadactyl limbs have similar structures but different functions?
6. What does variation in the pentadactyl limb among vertebrates provide evidence for?

4.7 Describe how genetic analysis has led to the suggestion of the three domains rather than the five kingdoms classification method

1. What is biological classification?
2. What are the three domains used to classify organisms?
3. What are the five kingdoms of the older classification system?
4. How has genetic analysis changed the classification of organisms?
5. Why can comparing DNA sequences provide evidence of evolutionary relationships?
6. Why does genetic evidence support classification into three domains?

4.8 Explain selective breeding and its impact on food plants and domesticated animals

1. What is selective breeding?
2. What are the main steps involved in selective breeding?
3. How can selective breeding increase milk production in cattle?
4. How can selective breeding produce crop plants with desirable characteristics?
5. How can repeated selective breeding increase the frequency of desirable alleles?
6. What is one disadvantage of selective breeding in domesticated animals or crops?

4.9B Describe the process of tissue culture and its advantages in medical research and plant breeding programmes

1. What is tissue culture?
2. How are cells used to produce genetically identical organisms during plant tissue culture?
3. Why are small pieces of plant tissue suitable for tissue culture?
4. How can tissue culture rapidly produce large numbers of plants with desirable characteristics?
5. How can tissue culture be used in medical research?
6. What is one advantage of using tissue culture in plant breeding programmes?

4.10 Describe genetic engineering as a process which involves modifying the genome of an organism to introduce desirable characteristics

1. What is genetic engineering?
2. What is the purpose of modifying an organism's genome during genetic engineering?
3. How can a gene from one organism be introduced into another organism?
4. Why can genetic engineering produce organisms with desirable characteristics?
5. How does genetic engineering differ from selective breeding?
6. What is a genetically modified organism?

4.11 Describe the main stages of genetic engineering including the use of restriction enzymes, ligase, sticky ends and vectors

1. What is the role of a restriction enzyme in genetic engineering?
2. What are sticky ends?
3. Why are sticky ends useful when inserting a gene into DNA?
4. What is the role of DNA ligase in genetic engineering?
5. What is a vector in genetic engineering?
6. What are the main stages used to insert a desired gene into an organism using genetic engineering?

4.12B Explain the advantages and disadvantages of genetic engineering to produce GM organisms including the introduction of genes for insect resistance from Bacillus thuringiensis into crop plants

1. What is one advantage of genetically modifying crops to produce insect resistance?
2. How can a gene from *Bacillus thuringiensis* give a crop plant insect resistance?
3. How can insect-resistant GM crops reduce the use of chemical insecticides?

4. What is one potential environmental risk of growing insect-resistant GM crops?
5. What is one potential disadvantage of genetically modified crops for farmers or consumers?
6. Why is the use of GM crops a subject of scientific and ethical debate?

4.13B Explain the advantages and disadvantages of agricultural solutions to the demands of a growing human population, including use of fertilisers and biological control

1. Why are fertilisers used in agriculture?
2. How can fertilisers increase crop yield?
3. What is biological control?
4. How can biological control reduce crop damage caused by pests?
5. What is one environmental disadvantage of excessive fertiliser use?
6. What is one advantage and one disadvantage of using biological control?

4.14 Evaluate the benefits and risks of genetic engineering and selective breeding in modern agriculture and medicine, including practical and ethical implications

1. What is one benefit of genetic engineering in agriculture?
2. What is one risk of genetic engineering in agriculture?
3. What is one benefit of selective breeding in agriculture?
4. What is one risk of selective breeding in domesticated animals?
5. What is one potential medical benefit of genetic engineering?
6. What practical and ethical issues should be considered when using genetic engineering or selective breeding?

Topic 5 – Health, disease and the development of medicines

5.1 Describe health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, as defined by the World Health Organization (WHO)

1. How does the World Health Organization define health?
2. What does physical well-being mean in the WHO definition of health?
3. What does mental well-being mean in the WHO definition of health?
4. What does social well-being mean in the WHO definition of health?
5. Why does being free from disease not necessarily mean that a person is considered completely healthy?

6. Which international organisation defines health as complete physical, mental and social well-being?

5.2 Describe the difference between communicable and non-communicable diseases

1. What is a communicable disease?
2. What is a non-communicable disease?
3. How are communicable diseases transmitted between organisms?
4. Why can non-communicable diseases not be transmitted between people?
5. Give one example of a communicable disease.
6. Give one example of a non-communicable disease.

5.3 Explain why the presence of one disease can lead to a higher susceptibility to other diseases

1. Why can having one disease increase a person's susceptibility to another disease?
2. How can a disease weaken the immune system?
3. Why does destruction of white blood cells increase susceptibility to other infections?
4. How can HIV infection increase susceptibility to other diseases?
5. Why can a weakened immune system make it more difficult to fight pathogens?
6. How can one disease indirectly increase the risk of developing another disease?

5.4 Describe a pathogen as a disease-causing organism, including viruses, bacteria, fungi and protists

1. What is a pathogen?
2. What is a bacterial pathogen?
3. What is a viral pathogen?
4. What is a fungal pathogen?
5. What is a protist pathogen?
6. Which four groups of pathogens are required by the Edexcel specification?

5.5 Describe some common infections, including cholera, tuberculosis, Chalara ash dieback, malaria, HIV, stomach ulcers caused by Helicobacter and Ebola

1. Which type of pathogen causes cholera, and what is a major symptom of cholera?
2. Which type of pathogen causes tuberculosis, and what part of the body can tuberculosis damage?

3. Which type of pathogen causes Chalara ash dieback, and what symptoms does it cause in ash trees?
4. Which type of pathogen causes malaria, and which organs can malaria damage?
5. Which type of pathogen causes HIV infection, and what cells does HIV destroy?
6. Which bacterium can cause stomach ulcers, and which virus causes Ebola?

5.6 Explain how pathogens are spread and how this spread can be reduced or prevented

1. How is cholera commonly spread?
2. How is tuberculosis commonly spread?
3. How can the spread of Chalara ash dieback occur?
4. How is malaria transmitted from one person to another?
5. How can stomach ulcers caused by *Helicobacter* be spread?
6. How is Ebola spread between people?

5.7B Describe the lifecycle of a virus, including lysogenic and lytic pathways

1. What happens when a virus attaches to a suitable host cell?
2. What happens to viral genetic material during viral replication?
3. What happens during the lytic pathway of a virus?
4. What happens during the lysogenic pathway of a virus?
5. How can viral genetic material remain inside a host cell during the lysogenic pathway?
6. What event causes the lysogenic pathway to enter the lytic pathway?

5.8 Explain how sexually transmitted infections (STIs) are spread and how this spread can be reduced or prevented, including Chlamydia and HIV

1. What is a sexually transmitted infection?
2. How is Chlamydia commonly transmitted?
3. How is HIV commonly transmitted?
4. How can condoms reduce the spread of STIs?
5. Why can testing and treatment help reduce the spread of Chlamydia?
6. Why can reducing contact with infected body fluids reduce HIV transmission?

5.9B Describe how some plants defend themselves against attack from pests and pathogens by physical barriers, including the leaf cuticle and cell wall

1. What is the function of the waxy leaf cuticle in plant defence?

2. How does the leaf cuticle reduce the entry of pathogens into a plant?
3. How does the plant cell wall help defend against pathogens?
4. Why does the physical structure of a plant cell wall make it difficult for pathogens to enter?
5. How do physical barriers protect plants before pathogens enter their cells?
6. Which two physical barriers are specifically required for plant defence in the Edexcel specification?

5.10B Describe how plants defend themselves against attack from pests and pathogens by producing chemicals, some of which can be used to treat human diseases or relieve symptoms

1. How can plants defend themselves against pests using chemicals?
2. How can plants defend themselves against pathogens using chemicals?
3. Why can plant-produced chemicals be useful in medicine?
4. How can plant chemicals be used to treat human diseases?
5. How can plant chemicals be used to relieve symptoms of human diseases?
6. Why can producing defensive chemicals increase a plant's ability to survive pathogen or pest attack?

5.11B Describe different ways plant diseases can be detected and identified, in the lab and in the field

1. Why should possible environmental causes be eliminated when diagnosing a plant disease?
2. How can the distribution of affected plants in a field help identify a plant disease?
3. What can visible symptoms tell scientists when identifying a plant disease?
4. How can laboratory diagnostic tests identify a plant pathogen?
5. Why is it useful to combine field observations with laboratory diagnostic testing?
6. What four approaches can be used to detect and identify plant diseases?

5.12 Describe how the physical barriers and chemical defences of the human body provide protection from pathogens

1. How does the skin act as a physical barrier against pathogens?
2. How does mucus help protect the human body from pathogens?
3. How do cilia help protect the respiratory system from pathogens?
4. How does lysozyme help defend the body against pathogens?
5. How does hydrochloric acid in the stomach help destroy pathogens?
6. Which physical and chemical defences protect humans from pathogens before a specific immune response occurs?

5.13 Explain the role of the specific immune system of the human body in defence against disease

1. What happens when a person is exposed to a pathogen for the first time?
2. What are antigens?
3. How do antigens trigger the production of specific antibodies?
4. What is the role of memory lymphocytes?
5. Why does the secondary immune response occur more rapidly than the primary response?
6. How does the production of memory lymphocytes provide long-term immunity to a pathogen?

5.14 Explain the body's response to immunisation using an inactive form of a pathogen

1. What is immunisation?
2. Why is an inactive form of a pathogen used in a vaccine?
3. How does a vaccine trigger an immune response?
4. What happens to antibody production after vaccination?
5. Why does vaccination lead to the production of memory lymphocytes?
6. Why can a vaccinated person produce antibodies more rapidly when exposed to the pathogen later?

5.15B Discuss the advantages and disadvantages of immunisation, including the concept of herd immunity

1. What is herd immunity?
2. How does a high vaccination rate reduce the spread of a communicable disease?
3. How does herd immunity help protect people who cannot be vaccinated?
4. What is one advantage of immunisation?
5. What is one disadvantage or risk associated with immunisation?
6. Why can vaccination programmes reduce the number of people infected during an outbreak?

5.16 Explain that antibiotics can only be used to treat bacterial infections because they inhibit cell processes in the bacterium but not the host organism

1. Why are antibiotics effective against bacterial infections?
2. Why do antibiotics not treat viral infections?
3. What is the target of an antibiotic within a bacterial cell?
4. Why can antibiotics inhibit bacterial cell processes without normally damaging human cells?
5. Why would taking antibiotics for a viral infection not cure the infection?

6. Why is it important to use antibiotics only when they are needed for bacterial infections?

5.17B Explain the aseptic techniques used in culturing microorganisms in the laboratory

1. What is the purpose of using an autoclave when preparing sterile growth medium?
2. Why are Petri dishes sterilised before microorganisms are cultured?
3. Why are sterile inoculating loops used to transfer microorganisms?
4. Why should Petri dishes and culture vials be kept covered?
5. How does aseptic technique reduce contamination of a microbial culture?
6. What is the purpose of using aseptic techniques when culturing microorganisms?

5.18B Core Practical: Investigate the effects of antiseptics, antibiotics or plant extracts on microbial cultures

1. How can the effectiveness of an antimicrobial substance be tested using a microbial culture?
2. What does a clear zone around an antimicrobial disc on agar indicate?
3. Why should the diameter of the clear zone be measured when comparing antimicrobial substances?
4. Why should the concentration of the antimicrobial substance be controlled or recorded?
5. Why should sterile technique be used when investigating antimicrobial substances?
6. How can repeated measurements improve the reliability of an investigation into antimicrobial effectiveness?

5.19B Calculate cross-sectional areas of bacterial cultures and clear agar jelly using πr^2

1. What equation is used to calculate the area of a circular bacterial culture?
2. What measurements are needed to calculate the cross-sectional area of a circular bacterial culture?
3. How can the radius of a bacterial culture be calculated from its diameter?
4. What is the cross-sectional area of a circular clear zone with a radius of 5 mm?
5. Why must the radius rather than the diameter be used in the equation πr^2?
6. How can the calculated area of a clear zone be used to compare antimicrobial effectiveness?

5.20 Describe that the process of developing new medicines, including antibiotics, has many stages, including discovery, development, preclinical and clinical testing

1. What is the discovery stage of developing a new medicine?
2. What happens during the development stage of medicine development?
3. What is preclinical testing?
4. What is clinical testing?
5. Why are medicines tested before they are given to large numbers of humans?
6. What are the main stages involved in developing a new medicine?

5.21B Describe the production of monoclonal antibodies

1. What type of cell is used to produce the desired antibody during monoclonal antibody production?
2. Why can the lymphocytes used in monoclonal antibody production not be used directly to produce large quantities of antibodies?
3. What is a hybridoma cell?
4. How are hybridoma cells produced?
5. Why are hybridoma cells useful for producing monoclonal antibodies?
6. How do hybridoma cells produce large quantities of identical antibodies?

5.22B Explain the use of monoclonal antibodies

1. How are monoclonal antibodies used in pregnancy tests?
2. How can monoclonal antibodies be used to locate blood clots?
3. How can monoclonal antibodies be used to locate cancer cells?
4. How can monoclonal antibodies be used to treat cancer?
5. Why can monoclonal antibodies target specific cells more precisely than some conventional drug treatments?
6. What is one advantage of using monoclonal antibodies compared with radiotherapy for targeting specific cells?

5.23 Describe that many non-communicable human diseases are caused by the interaction of a number of factors

1. What is a non-communicable disease?
2. Why can many non-communicable diseases be caused by several interacting factors?
3. Which type of disease includes cardiovascular disease?
4. Which types of cancer can be influenced by multiple factors?
5. How can nutrition influence the risk of non-communicable disease?

6. Which types of diseases listed in the Edexcel specification can result from interactions between multiple factors?

5.24 Explain the effect of lifestyle factors on non-communicable diseases at local, national and global levels

1. What is the equation for calculating BMI?
2. What does a high BMI indicate about a person's body mass relative to their height?
3. How can exercise and diet affect the risk of obesity?
4. How can poor nutrition contribute to malnutrition?
5. How can excessive alcohol consumption increase the risk of liver disease?
6. How can smoking increase the risk of cardiovascular disease?

5.25 Evaluate some different treatments for cardiovascular disease, including life-long medication, surgical procedures and lifestyle changes

1. How can life-long medication be used to treat cardiovascular disease?
2. How can surgical procedures treat cardiovascular disease?
3. How can lifestyle changes reduce the risk or severity of cardiovascular disease?
4. What is one advantage of using medication to treat cardiovascular disease?
5. What is one advantage and one risk of using surgical procedures to treat cardiovascular disease?
6. Why might lifestyle changes be recommended alongside medication or surgery for cardiovascular disease?

Topic 6 – Plant structures and their functions

6.1 Describe photosynthetic organisms as the main producers of food and therefore biomass

1. What are photosynthetic organisms, and why are they described as the main producers of food and biomass?
2. Why are green plants and algae important producers in ecosystems?
3. How does photosynthesis allow plants and algae to produce food?
4. Why does the glucose produced by photosynthetic organisms contribute to biomass?
5. What is meant by the term biomass in the context of photosynthetic organisms?
6. Why do consumers ultimately depend on photosynthetic organisms for food and biomass?

6.2 Describe photosynthesis in plants and algae as an endothermic reaction that uses light energy to react carbon dioxide and water to produce glucose and oxygen

1. What is the word equation for photosynthesis?
2. Why is photosynthesis described as an endothermic reaction?
3. What form of energy is transferred to the plant during photosynthesis?
4. Which two substances are the reactants in photosynthesis?
5. Which two substances are produced during photosynthesis?
6. Where does the light energy used in photosynthesis come from?

6.3 Explain the effect of temperature, light intensity and carbon dioxide concentration as limiting factors on the rate of photosynthesis

1. How does increasing temperature affect the rate of photosynthesis when temperature is a limiting factor?
2. Why does increasing light intensity increase the rate of photosynthesis at low light intensities?
3. Why does increasing carbon dioxide concentration increase the rate of photosynthesis when carbon dioxide is limiting?
4. What happens to the rate of photosynthesis when a limiting factor is increased beyond the point where another factor becomes limiting?
5. What is meant by a limiting factor in photosynthesis?
6. How can temperature, light intensity and carbon dioxide concentration each limit the rate of photosynthesis?

6.4 Explain the interactions of temperature, light intensity and carbon dioxide concentration in limiting the rate of photosynthesis

1. How can increasing light intensity fail to increase the rate of photosynthesis?
2. How can increasing carbon dioxide concentration fail to increase the rate of photosynthesis?
3. Why must temperature, light intensity and carbon dioxide concentration be considered together when investigating photosynthesis?
4. How can two limiting factors interact to determine the rate of photosynthesis?
5. What would happen to the rate of photosynthesis if light intensity and carbon dioxide concentration were high but temperature was too low?
6. Why does changing one environmental factor sometimes have little effect on the rate of photosynthesis?

6.5 Core Practical: Investigate the effect of light intensity on the rate of photosynthesis

1. How could you investigate the effect of light intensity on the rate of photosynthesis?
2. How could the rate of photosynthesis be measured in an investigation using an aquatic plant?
3. What variable should be changed when investigating the effect of light intensity on photosynthesis?
4. Which variables should be controlled when investigating the effect of light intensity on photosynthesis?
5. Why should the distance between the light source and plant be measured accurately?
6. Why should the investigation be repeated at each light intensity?

6.6 Explain how the rate of photosynthesis is directly proportional to light intensity and inversely proportional to the distance from a light source, including the use of the inverse square law calculation

1. How is the rate of photosynthesis related to light intensity when light intensity is the limiting factor?
2. How is light intensity related to the distance from a light source?
3. What happens to light intensity when the distance from a light source is doubled?
4. What is the inverse square law for light intensity?
5. If the distance from a light source is tripled, by what factor does the light intensity change?
6. How can the inverse square law be used to compare photosynthesis rates at different distances from a light source?

6.7 Explain how the structure of the root hair cells is adapted to absorb water and mineral ions

1. How does the long extension of a root hair cell help it absorb substances from the soil?
2. Why does a root hair cell have a large surface area?
3. How does the thin surface of a root hair cell help water absorption?
4. How are mineral ions absorbed into root hair cells?
5. Why do root hair cells contain many mitochondria?
6. How is the structure of a root hair cell adapted for absorbing water and mineral ions?

6.8 Explain how the structures of the xylem and phloem are adapted to their function in the plant, including: a lignified dead cells in xylem transporting water and minerals through the plant b living cells in phloem using energy to transport sucrose around the plant

1. How are xylem vessels adapted to transport water and mineral ions through a plant?
2. Why are xylem vessels made from dead cells?
3. What is the function of lignin in xylem vessels?
4. How are phloem tissues adapted to transport sucrose around a plant?
5. Why do phloem cells require energy to transport sucrose?
6. What are the key structural and functional differences between xylem and phloem?

6.9 Explain how water and mineral ions are transported through the plant by transpiration, including the structure and function of the stomata

1. What is transpiration?
2. How does transpiration help transport water through a plant?
3. How does water move from the roots to the leaves through the xylem?
4. What is the function of stomata in a plant?
5. How does water vapour leave a leaf through the stomata?
6. How do stomata control the movement of gases and water vapour into and out of a leaf?

6.10 Describe how sucrose is transported around the plant by translocation

1. What is translocation in plants?
2. Which substance is transported through the phloem by translocation?
3. From where to where can sucrose be transported by translocation?
4. Why is translocation important for plants?
5. Which tissue transports sucrose around a plant?
6. How does translocation differ from the transport of water in the xylem?

6.11B Explain how the structure of a leaf is adapted for photosynthesis and gas exchange

1. How is the broad shape of a leaf adapted for photosynthesis?
2. How are the palisade cells adapted for photosynthesis?
3. How does the thin structure of a leaf help gas exchange?
4. How do stomata allow gas exchange in a leaf?
5. How are air spaces inside the leaf adapted for gas exchange?
6. How is the structure of a leaf adapted to maximise photosynthesis while allowing efficient gas exchange?

6.12 Explain the effect of environmental factors on the rate of water uptake by a plant, to include light intensity, air movement and temperature

1. How does increasing light intensity affect the rate of water uptake by a plant?

2. How does increasing air movement affect the rate of water uptake by a plant?
3. How does increasing temperature affect the rate of water uptake by a plant?
4. Why does increased air movement usually increase transpiration and water uptake?
5. Why does increasing temperature usually increase transpiration and water uptake?
6. How do light intensity, air movement and temperature affect water uptake by a plant?

6.13 Demonstrate an understanding of rate calculations for transpiration

1. How is the rate of transpiration calculated from the amount of water lost and the time taken?
2. A plant loses 6 cm^3 of water in 3 hours. What is its mean rate of water loss?
3. A plant loses 0.8 g of water in 20 minutes. What is its rate of water loss in g/min?
4. Why is the time unit important when calculating the rate of transpiration?
5. How could a change in mass be used to calculate the rate of water loss from a plant?
6. What measurements are needed to calculate the rate of transpiration?

6.14B Explain how plants are adapted to survive in extreme environments including the effect of leaf size and shape, the cuticle and stomata

1. How does a small leaf size help a plant survive in a dry environment?
2. How can leaf shape reduce water loss in plants adapted to extreme environments?
3. How does a thick waxy cuticle help a plant survive in dry conditions?
4. How can the position or number of stomata reduce water loss?
5. Why might plants adapted to dry environments have fewer stomata?
6. How do leaf size, leaf shape, the cuticle and stomata help plants survive extreme environments?

6.15B Explain how plant hormones control and coordinate plant growth and development, including the role of auxins in phototropisms and gravitropisms

1. What is the role of plant hormones in controlling and coordinating plant growth?
2. What is a phototropism?
3. How do auxins cause a plant shoot to grow towards light?
4. What is a gravitropism?
5. How do auxins cause plant roots to respond to gravity?
6. How do auxins coordinate growth responses in plant shoots and roots?

6.16B Describe the commercial uses of auxins, gibberellins and ethene in plants, including: a auxins in weedkillers and rooting powders b gibberellins in germination, fruit and flower formation and the production of seedless fruit c ethene in fruit ripening

1. How are auxins used commercially as weedkillers?
2. How are auxins used commercially in rooting powders?
3. How are gibberellins used commercially to promote germination?
4. How are gibberellins used commercially in fruit and flower formation and the production of seedless fruit?
5. How is ethene used commercially in fruit ripening?
6. What are the main commercial uses of auxins, gibberellins and ethene?

Topic 7 – Animal coordination, control and homeostasis

7.1 Hormonal coordination

7.1 Describe where hormones are produced and how they are transported from endocrine glands to their target organs, including the pituitary gland, thyroid gland, pancreas, adrenal glands, ovaries and testes

1. Where are hormones produced in the human body?
2. How are hormones transported from endocrine glands to their target organs?
3. What is the function of the pituitary gland as an endocrine gland?
4. What is the function of the thyroid gland as an endocrine gland?
5. Which hormones are associated with the pancreas, adrenal glands, ovaries and testes?
6. What are the target organs of hormones and how do hormones affect them?

7.2 Explain that adrenalin is produced by the adrenal glands to prepare the body for fight or flight, including: a increased heart rate b increased blood pressure c increased blood flow to the muscles d raised blood sugar levels by stimulating the liver to change glycogen into glucose

1. Where is adrenalin produced in the human body?
2. What is the role of adrenalin in the fight-or-flight response?
3. How does adrenalin affect heart rate during the fight-or-flight response?
4. How does adrenalin affect blood pressure during the fight-or-flight response?

5. How does adrenalin increase blood flow to muscles during the fight-or-flight response?
6. How does adrenalin increase blood glucose concentration during the fight-or-flight response?

7.3 Explain how thyroxine controls metabolic rate as an example of negative feedback, including: a low levels of thyroxine stimulates production of TRH in hypothalamus b this causes release of TSH from the pituitary gland c TSH acts on the thyroid to produce thyroxine d when thyroxine levels are normal thyroxine inhibits the release of TRH and the production of TSH

1. What is the role of thyroxine in controlling metabolic rate?
2. What happens to TRH production when thyroxine levels are low?
3. What effect does TRH have on the pituitary gland?
4. What effect does TSH have on the thyroid gland?
5. What happens to TRH and TSH production when thyroxine levels return to normal?
6. Why is thyroxine regulation an example of negative feedback?

7.4 Describe the stages of the menstrual cycle, including the roles of the hormones oestrogen and progesterone, in the control of the menstrual cycle

1. What happens to the uterus lining during menstruation?
2. What happens to the uterus lining during the first part of the menstrual cycle?
3. What role does oestrogen have in repairing and maintaining the uterus lining?
4. What happens during ovulation in the menstrual cycle?
5. What role does progesterone have after ovulation?
6. What happens to progesterone levels if fertilisation does not occur?

7.5 Explain the interactions of oestrogen, progesterone, FSH and LH in the control of the menstrual cycle, including the repair and maintenance of the uterus wall, ovulation and menstruation

1. What role does FSH play at the beginning of the menstrual cycle?
2. What role does oestrogen play in the menstrual cycle?
3. How does oestrogen affect FSH production during the menstrual cycle?
4. What role does LH play in causing ovulation?
5. What role does progesterone play in maintaining the uterus lining?
6. How do changes in progesterone and oestrogen levels cause menstruation?

7.6 Explain how hormonal contraception influences the menstrual cycle and prevents pregnancy

1. How does hormonal contraception prevent pregnancy?
2. How can hormonal contraception prevent ovulation?
3. How can hormonal contraception affect FSH and LH levels?
4. How can hormonal contraception alter the uterus lining?
5. How can hormonal contraception make it more difficult for sperm to reach an egg?
6. Why does hormonal contraception reduce the chance of fertilisation and pregnancy?

7.7 Evaluate hormonal and barrier methods of contraception

1. What is a hormonal method of contraception?
2. What is a barrier method of contraception?
3. How does the contraceptive pill prevent pregnancy?
4. How does a condom prevent pregnancy?
5. What are advantages of hormonal contraception compared with barrier contraception?
6. What are advantages and disadvantages of barrier contraception compared with hormonal contraception?

7.8 Explain the use of hormones in Assisted Reproductive Technology (ART) including IVF and clomifene therapy

1. What is the role of hormones in IVF treatment?
2. How are hormones used to stimulate egg production during IVF?
3. What is IVF?
4. Why are hormones used to control ovulation during IVF?
5. What is clomifene therapy used to treat?
6. How does clomifene therapy increase the chance of ovulation?

7.9 Explain the importance of maintaining a constant internal environment in response to internal and external change

1. What is meant by maintaining a constant internal environment?
2. Why must organisms maintain a constant internal environment?
3. How can changes in external temperature affect the internal environment?
4. How can changes in blood glucose concentration affect the internal environment?
5. How can changes in water concentration affect the internal environment?
6. What is homeostasis and why is it important for cells?

7.10B Explain the importance of homeostasis, including: a thermoregulation – the effect on enzyme activity b osmoregulation – the effect on animal cells

1. What is homeostasis?

2. Why is thermoregulation important for enzyme activity?
3. What can happen to enzymes if body temperature becomes too high?
4. What is osmoregulation?
5. Why is osmoregulation important for animal cells?
6. What can happen to animal cells if the water concentration of their surroundings changes significantly?

7.11B Explain how thermoregulation takes place, with reference to the function of the skin, including: a the role of the dermis b the role of the epidermis c the role of the hypothalamus

1. What is the function of the dermis in thermoregulation?
2. What is the function of the epidermis in the skin?
3. What role does the hypothalamus play in thermoregulation?
4. How does the hypothalamus detect changes in body temperature?
5. How does the skin help maintain a constant body temperature?
6. How do the dermis, epidermis and hypothalamus work together in thermoregulation?

7.12B Explain how thermoregulation takes place, with reference to: a shivering b vasoconstriction c vasodilation

1. How does shivering increase body temperature?
2. What is vasoconstriction?
3. How does vasoconstriction reduce heat loss from the body?
4. What is vasodilation?
5. How does vasodilation increase heat loss from the body?
6. How do shivering, vasoconstriction and vasodilation help maintain body temperature?

7.13 Explain how the hormone insulin controls blood glucose concentration

1. Where is insulin produced?
2. What happens to insulin secretion when blood glucose concentration increases?
3. How does insulin reduce blood glucose concentration?
4. How does insulin affect the uptake of glucose by body cells?
5. How does insulin affect glycogen formation in the liver?
6. Why does insulin help maintain a stable blood glucose concentration?

7.14 Explain how blood glucose concentration is regulated by glucagon

1. Where is glucagon produced?
2. What happens to glucagon secretion when blood glucose concentration becomes too low?

3. How does glucagon increase blood glucose concentration?
4. What effect does glucagon have on glycogen in the liver?
5. How do insulin and glucagon work together to regulate blood glucose concentration?
6. Why is glucagon important during periods when blood glucose concentration is low?

7.15 Explain the cause of type 1 diabetes and how it is controlled

1. What causes type 1 diabetes?
2. Why does a person with type 1 diabetes have insufficient insulin?
3. How does type 1 diabetes affect blood glucose concentration?
4. How can type 1 diabetes be controlled?
5. Why must people with type 1 diabetes monitor their blood glucose concentration?
6. How does insulin treatment help a person with type 1 diabetes?

7.16 Explain the cause of type 2 diabetes and how it is controlled

1. What causes type 2 diabetes?
2. What is insulin resistance?
3. How does type 2 diabetes affect blood glucose concentration?
4. How can changes in diet help control type 2 diabetes?
5. How can regular exercise help control type 2 diabetes?
6. How can medication be used to control type 2 diabetes?

7.17 Evaluate the correlation between body mass and type 2 diabetes including waist:hip calculations and BMI, using the BMI equation

1. What is the relationship between increased body mass and the risk of developing type 2 diabetes?
2. What does BMI measure?
3. What is the equation used to calculate BMI?
4. How is waist-to-hip ratio calculated?
5. Why can BMI and waist-to-hip ratio be useful when assessing the risk of type 2 diabetes?
6. What are limitations of using BMI to assess an individual's risk of type 2 diabetes?

7.18B Describe the structure of the urinary system

1. What are the main organs of the human urinary system?
2. What is the function of the kidneys in the urinary system?
3. What is the function of the ureters?
4. What is the function of the bladder?

5. What is the function of the urethra?
6. What is the pathway taken by urine from the kidneys to outside the body?

7.19B Explain how the structure of the nephron is related to its function in filtering the blood and forming urine including: a filtration in the glomerulus and Bowman's capsule b selective reabsorption of glucose c reabsorption of water

1. What is a nephron?
2. Where does filtration of the blood occur in a nephron?
3. What happens to small molecules during filtration in the glomerulus and Bowman's capsule?
4. Where is glucose selectively reabsorbed in the nephron?
5. Why is glucose normally completely reabsorbed from the filtrate?
6. How is water reabsorbed from the filtrate during urine formation?

7.20B Explain the effect of ADH on the permeability of the collecting duct in regulating the water content of the blood

1. Where is ADH produced and released?
2. What happens to ADH levels when the water content of the blood is too low?
3. How does ADH affect the permeability of the collecting duct?
4. How does increased ADH concentration affect water reabsorption?
5. What happens to the volume and concentration of urine when ADH levels increase?
6. What happens to ADH levels when the water content of the blood is too high?

7.21B Describe the treatments for kidney failure, including kidney dialysis and organ donation

1. What is kidney failure?
2. How does kidney dialysis help a person with kidney failure?
3. What substances are removed from the blood during dialysis?
4. What are the disadvantages of long-term kidney dialysis?
5. How can a kidney transplant treat kidney failure?
6. What are the advantages and disadvantages of receiving a donated kidney?

7.22B State that urea is produced from the breakdown of excess amino acids in the liver

1. Where is urea produced?
2. From what substances is urea produced?
3. Why is urea produced from excess amino acids?

4. Why can excess amino acids not simply be stored in the body?
5. What happens to excess amino acids before urea is produced?
6. Which organ removes urea from the blood and forms it into urine?

Topic 8 – Exchange and transport in animals

8.1 Describe the need to transport substances into and out of a range of organisms, including oxygen, carbon dioxide, water, dissolved food molecules, mineral ions and urea

1. Why do multicellular organisms need to transport substances into and out of their cells?
2. Why do multicellular organisms need to transport oxygen to their cells?
3. Why do multicellular organisms need to transport carbon dioxide away from their cells?
4. Why do multicellular organisms need to transport water and mineral ions around the body?
5. Why do multicellular organisms need to transport dissolved food molecules to their cells?
6. Why does urea need to be transported away from cells?

8.2 Explain the need for exchange surfaces and a transport system in multicellular organisms including the calculation of surface area : volume ratio

1. Why do multicellular organisms need specialised exchange surfaces?
2. Why do multicellular organisms need transport systems?
3. Why does a large surface area : volume ratio increase the efficiency of exchange?
4. How is surface area : volume ratio calculated?
5. How does an organism's size affect its surface area : volume ratio?
6. Why can simple diffusion alone be insufficient to supply the needs of large multicellular organisms?

8.3 Explain how alveoli are adapted for gas exchange by diffusion between air in the lungs and blood in capillaries

1. How are alveoli adapted to provide a large surface area for gas exchange?
2. How does the thin wall of an alveolus increase the rate of gas exchange?
3. How does the blood supply around alveoli maintain a concentration gradient for diffusion?
4. How does ventilation of the lungs maintain a concentration gradient for gas exchange?
5. How does oxygen diffuse from the alveoli into the blood?
6. How does carbon dioxide diffuse from the blood into the alveoli?

8.4B Describe the factors affecting the rate of diffusion, including surface area, concentration gradient and diffusion distance

1. How does increasing surface area affect the rate of diffusion?
2. How does increasing the concentration gradient affect the rate of diffusion?
3. How does increasing diffusion distance affect the rate of diffusion?
4. Why does a larger surface area allow substances to diffuse more quickly?
5. Why does a steeper concentration gradient increase the rate of diffusion?
6. Why does a shorter diffusion distance increase the rate of diffusion?

8.5B Calculate the rate of diffusion using Fick's law: surface area concentration difference diffusion thickness of membrane rate of × α

1. What factors are directly proportional to the rate of diffusion according to Fick's law?
2. What factor is inversely proportional to the rate of diffusion according to Fick's law?
3. How does doubling the surface area affect the rate of diffusion if all other factors remain constant?
4. How does doubling the concentration difference affect the rate of diffusion if all other factors remain constant?
5. How does doubling the thickness of a membrane affect the rate of diffusion if all other factors remain constant?
6. How can Fick's law be used to calculate a change in the rate of diffusion?

8.6 Explain how the structure of the blood is related to its function: a red blood cells (erythrocytes) b white blood cells (phagocytes and lymphocytes) c plasma d platelets

1. How is the structure of a red blood cell adapted for transporting oxygen?
2. How are phagocytes adapted to defend the body against pathogens?
3. How are lymphocytes adapted to defend the body against pathogens?
4. What is the function of plasma in the blood?
5. What is the function of platelets in the blood?
6. How does the structure of blood allow it to transport substances and defend the body?

8.7 Explain how the structure of the blood vessels is related to their function

1. How is the structure of an artery adapted to withstand high blood pressure?
2. How is the structure of a vein adapted to return blood to the heart?
3. How are valves in veins adapted to prevent the backflow of blood?

4. How is the structure of a capillary adapted for exchange of substances with tissues?
5. Why do capillaries have walls that are only one cell thick?
6. How do the structures of arteries, veins and capillaries differ according to their functions?

8.8 Explain how the structure of the heart and circulatory system is related to its function, including the role of the major blood vessels, the valves and the relative thickness of chamber walls

1. How does the structure of the heart allow it to pump blood around the body?
2. What is the function of the major blood vessels connected to the heart?
3. What is the function of the valves in the heart?
4. Why is the wall of the left ventricle thicker than the wall of the right ventricle?
5. Why are the walls of the atria thinner than the walls of the ventricles?
6. How does the circulatory system ensure that oxygenated and deoxygenated blood are transported to the correct locations?

8.9 Describe cellular respiration as an exothermic reaction which occurs continuously in living cells to release energy for metabolic processes, including aerobic and anaerobic respiration

1. What is cellular respiration?
2. Why is cellular respiration described as an exothermic reaction?
3. Why does cellular respiration occur continuously in living cells?
4. What is the purpose of the energy released by cellular respiration?
5. What is aerobic respiration?
6. What is anaerobic respiration?

8.10 Compare the process of aerobic respiration with the process of anaerobic respiration

1. What is the difference between aerobic and anaerobic respiration?
2. Which type of respiration requires oxygen?
3. Which type of respiration releases more energy per glucose molecule?
4. What are the products of aerobic respiration?
5. What are the products of anaerobic respiration in human muscle cells?
6. Why does anaerobic respiration occur during vigorous exercise?

8.11 Core Practical: Investigate the rate of respiration in living organisms

1. How can the rate of respiration in a living organism be investigated experimentally?

2. What measurement could be taken to determine the rate of respiration in a respiration experiment?
3. Why should temperature be controlled when investigating the rate of respiration?
4. Why is a control experiment needed when investigating the rate of respiration?
5. How can the rate of respiration be calculated from experimental data?
6. What variables should be controlled when investigating the rate of respiration in living organisms?

8.12 Calculate heart rate, stroke volume and cardiac output, using the equation cardiac output = stroke volume × heart rate

1. What is meant by heart rate?
2. What is meant by stroke volume?
3. What is meant by cardiac output?
4. How is cardiac output calculated from stroke volume and heart rate?
5. What happens to cardiac output if heart rate increases while stroke volume remains constant?
6. What happens to cardiac output if stroke volume increases while heart rate remains constant?

Topic 9 – Ecosystems and material cycles

9.1 Describe the different levels of organisation from individual organisms, populations, communities, to the whole ecosystem

1. What is an organism in an ecosystem?
2. What is a population in an ecosystem?
3. What is a community in an ecosystem?
4. What is an ecosystem?
5. What is the difference between a population and a community?
6. What is the correct order of organisation from an individual organism to an ecosystem?

9.2 Explain how communities can be affected by abiotic and biotic factors, including: a temperature, light, water, pollutants b competition, predation

1. How can temperature affect the organisms present in a community?
2. How can light intensity affect the organisms present in a community?
3. How can water availability affect the organisms present in a community?
4. How can pollutants affect the organisms present in a community?
5. How can competition affect the size of populations within a community?
6. How can predation affect the size of populations within a community?

9.3 Describe the importance of interdependence in a community

1. What is meant by interdependence between organisms in a community?
2. Why are organisms in a community dependent on other organisms?
3. How can a change in one population affect other populations in a community?
4. How does interdependence contribute to the stability of a community?
5. How can removing one species affect an interdependent community?
6. Why can changes in the population of one species have effects throughout a community?

9.4 Describe how the survival of some organisms is dependent on other species, including parasitism and mutualism

1. What is parasitism?
2. How does a parasite benefit from its host?
3. How can parasitism affect the survival of a host organism?
4. What is mutualism?
5. How do both organisms benefit from a mutualistic relationship?
6. Why can the survival of some organisms depend on a mutualistic relationship with another species?

9.5 Core Practical: Investigate the relationship between organisms and their environment using field-work techniques, including quadrats and belt transects

1. How is a quadrat used to investigate the distribution of organisms in a habitat?
2. Why should quadrats be placed randomly when investigating the distribution of organisms?
3. How is a belt transect used to investigate changes in the distribution of organisms across a habitat?
4. Why are several quadrats used when investigating organisms in a habitat?
5. How can a belt transect be used to investigate the effect of an environmental gradient on organisms?
6. What measurements can be collected using quadrats and belt transects during ecological fieldwork?

9.6 Explain how to determine the number of organisms in a given area using raw data from field-work techniques, including quadrats and belt transects

1. How can the number of organisms in a given area be estimated using quadrat data?
2. How can the mean number of organisms per quadrat be calculated?
3. How can the estimated total number of organisms in a habitat be calculated from quadrat data?

4. How can quadrat data be used to estimate population density?
5. How can belt transect data be used to determine how organism numbers change across a habitat?
6. Why does using multiple quadrats improve the reliability of an estimate of organism numbers?

9.7B Explain how some energy is transferred to less useful forms at each trophic level and that this affects the number of organisms at each trophic level, limits the length of a food chain and determines the shape of a pyramid of biomass in an ecosystem

1. Why is less energy available at each successive trophic level in a food chain?
2. How is energy transferred to less useful forms at each trophic level?
3. Why does the amount of energy available affect the number of organisms at each trophic level?
4. Why are food chains usually limited in length?
5. How does energy transfer between trophic levels affect the shape of a pyramid of biomass?
6. Why does a pyramid of biomass usually become narrower at higher trophic levels?

9.8B Calculate the efficiency of energy transfers between trophic levels and percentage calculations of biomass

1. How is the efficiency of an energy transfer between trophic levels calculated?
2. How is the percentage change in biomass calculated?
3. How can the efficiency of energy transfer be calculated when the energy entering and leaving a trophic level are known?
4. What percentage efficiency results when 2000 kJ of energy enters a trophic level and 200 kJ is transferred to the next trophic level?
5. What percentage of biomass is transferred if a trophic level contains 500 kg of biomass and 50 kg is transferred to the next trophic level?
6. Why is the efficiency of energy transfer between trophic levels usually less than 100%?

9.9 Explain the positive and negative human interactions within ecosystems and their impacts on biodiversity, including: a fish farming b introduction of non-indigenous species c eutrophication

1. How can fish farming have positive effects on food production?
2. How can fish farming negatively affect biodiversity?
3. How can introducing a non-indigenous species affect biodiversity?
4. Why can a non-indigenous species become invasive?

5. What is eutrophication?
6. How can eutrophication reduce biodiversity in an aquatic ecosystem?

9.10 Explain the benefits of maintaining local and global biodiversity, including the conservation of animal species and the impact of reforestation

1. What is biodiversity?
2. Why is maintaining biodiversity important for ecosystems?
3. How can conserving animal species help maintain biodiversity?
4. What are the benefits of maintaining global biodiversity?
5. How can reforestation increase biodiversity?
6. How can reforestation benefit ecosystems and the environment?

9.11B Describe the biological factors affecting levels of food security, including: a increasing human population b increasing animal farming and the increased meat and fish consumption c the impact of new pests and pathogens d environmental change caused by human activity e sustainability issues, e.g. use of land for biofuel production and the cost of agricultural inputs

1. How can an increasing human population affect global food security?
2. How can increasing animal farming affect food security?
3. How can increased meat and fish consumption affect food security?
4. How can new pests and pathogens reduce food security?
5. How can environmental change caused by human activity affect food security?
6. How can the use of land for biofuel production and the cost of agricultural inputs affect food security?

9.12 Describe how different materials cycle through the abiotic and biotic components of an ecosystem

1. What is meant by an abiotic component of an ecosystem?
2. What is meant by a biotic component of an ecosystem?
3. How do materials move between abiotic and biotic components of an ecosystem?
4. Why must materials be recycled within ecosystems?
5. Which processes allow materials to move between living organisms and the non-living environment?
6. How do material cycles help maintain ecosystems?

9.13 Explain the importance of the carbon cycle, including the processes involved and the role of microorganisms as decomposers

1. Why is the carbon cycle important to ecosystems?
2. How does photosynthesis remove carbon dioxide from the atmosphere?

3. How does respiration return carbon dioxide to the atmosphere?
4. How does combustion return carbon dioxide to the atmosphere?
5. How do microorganisms act as decomposers in the carbon cycle?
6. How does decomposition return carbon compounds to the environment?

9.14 Explain the importance of the water cycle, including the processes involved and the production of potable water in areas of drought including desalination

1. Why is the water cycle important to ecosystems?
2. How does evaporation contribute to the water cycle?
3. How does condensation contribute to the water cycle?
4. How does precipitation return water to the Earth's surface?
5. How can desalination produce potable water in areas affected by drought?
6. Why is desalination useful in areas where freshwater supplies are limited?

9.15 Explain how nitrates are made available for plant uptake, including the use of fertilisers, crop rotation and the role of bacteria in the nitrogen cycle

1. Why do plants need nitrate ions?
2. How can fertilisers increase the availability of nitrates for plant uptake?
3. How does crop rotation increase the availability of nitrates in soil?
4. What role do bacteria play in making nitrates available to plants?
5. How do nitrogen-fixing bacteria contribute to the nitrogen cycle?
6. Why are bacteria important for maintaining the supply of nitrogen compounds available to plants?

9.16B Evaluate the use of indicator species as evidence to assess the level of pollution, including: a polluted water – bloodworm, sludgeworm b clean water – freshwater shrimps, stonefly c air quality – different species of lichen, blackspot fungus on roses

1. What are indicator species?
2. Which organisms can indicate polluted water?
3. Which organisms can indicate clean water?
4. How can different species of lichen be used to assess air quality?
5. How can blackspot fungus on roses be used as an indicator of air quality?
6. Why are indicator species useful for assessing levels of pollution?

9.17B Explain the effects of temperature, water content and oxygen availability on the rate of decomposition in food preservation

1. How does temperature affect the rate of decomposition during food preservation?

2. How does water content affect the rate of decomposition during food preservation?
3. How does oxygen availability affect the rate of decomposition during food preservation?
4. Why does reducing temperature slow decomposition during food preservation?
5. Why does reducing water availability slow decomposition during food preservation?
6. Why can reducing oxygen availability slow the decomposition of food?

9.18B Explain the effects of temperature, water content and oxygen availability on the rate of decomposition in composting

1. How does temperature affect the rate of decomposition during composting?
2. How does water content affect the rate of decomposition during composting?
3. How does oxygen availability affect the rate of decomposition during composting?
4. Why does increasing temperature within suitable limits increase the rate of decomposition in composting?
5. Why is sufficient water important for decomposition during composting?
6. Why is oxygen availability important for aerobic decomposition during composting?

9.19B Calculate rate changes in the decay of biological material

1. How is the rate of decay of biological material calculated?
2. What measurements are needed to calculate the rate of decay?
3. How can the rate of decay be calculated from a change in mass over a given time?
4. A biological material loses 30 g of mass in 10 days; what is its average rate of decay?
5. A biological material loses 48 g of mass in 12 hours; what is its average rate of decay?
6. How can rates of decay be compared when biological materials are decomposing under different conditions?