

Paper 1:

Topic 1 – Cell Biology

4.1.1.1 Eukaryotes and Prokaryotes

1. What is the difference between a eukaryotic cell and a prokaryotic cell?
2. Which type of cell has its genetic material enclosed inside a nucleus?
3. What is the function of a bacterial plasmid?
4. State two structures found in both bacterial and animal cells.
5. Why are bacterial cells described as prokaryotic?
6. Explain one way that bacterial cells differ from plant cells.

4.1.1.2 Animal and Plant Cells

1. Name the five main sub-cellular structures found in an animal cell.
2. Which three structures are found in plant cells but not animal cells?
3. What is the function of the nucleus?
4. What is the function of mitochondria?
5. Explain why plant cells contain chloroplasts but animal cells do not.
6. Explain why a plant cell needs a cellulose cell wall.

Required Practical 1: Using a Light Microscope

1. What type of microscope is used in the required practical to observe plant and animal cells?
2. Which two types of cells are commonly observed in the microscopy required practical?
3. What must always be included with a biological drawing made using a microscope?
4. Why is iodine stain used when observing plant cells under a light microscope?
5. Explain why the microscope should be focused using the low-power objective lens before switching to a higher magnification.
6. Explain why biological drawings should be drawn using clear, continuous lines without shading.

4.1.1.3 Cell Specialisation

1. What is meant by a specialised cell?
2. State one adaptation of a sperm cell.
3. State one adaptation of a nerve cell.
4. State one adaptation of a root hair cell.
5. Explain how the structure of a muscle cell helps it carry out its function.
6. Explain why xylem cells are adapted for transporting water.

4.1.1.4 Cell Differentiation

1. What is meant by cell differentiation?
2. At what stage do most animal cells differentiate?
3. Why can many plant cells continue to differentiate throughout their lives?
4. Why is cell division in mature animals mainly restricted to repair and replacement?
5. Explain how differentiation produces specialised cells.
6. Explain why specialised cells contain different sub-cellular structures.

4.1.1.5 Microscopy

1. Which type of microscope has the greatest magnification?
2. Which type of microscope has the greatest resolving power?
3. What is meant by the resolution of a microscope?
4. What equation is used to calculate magnification?
5. Explain why electron microscopes have improved scientists' understanding of cell structure.
6. Calculate the magnification of an image that is 20 mm long if the real object is 0.02 mm long.

4.1.2.1 Chromosomes

1. Where are chromosomes found in a cell?
2. What molecule are chromosomes made from?
3. What is a gene?
4. How are chromosomes usually arranged in human body cells?
5. Explain why chromosomes are important.
6. Explain the relationship between DNA, chromosomes and genes.

4.1.2.2 Mitosis and the Cell Cycle

1. What is mitosis?

2. What happens to the DNA before a cell divides?
3. How many genetically identical cells are produced by mitosis?
4. Why do cells increase the number of mitochondria and ribosomes before dividing?
5. Explain why mitosis is important for growth and repair.
6. Describe the three main stages of the cell cycle.

4.1.2.3 Stem Cells

1. What is a stem cell?
2. Where are stem cells found in human embryos?
3. Where are stem cells found in adult humans?
4. How can stem cells from plant meristems be useful in agriculture?
5. Explain one medical use of stem cells.
6. Explain one ethical concern about the use of embryonic stem cells.

4.1.3.1 Diffusion

1. What is diffusion?
2. In which direction do particles move during diffusion?
3. State three factors that affect the rate of diffusion.
4. Why do single-celled organisms not need specialised exchange surfaces?
5. Explain why multicellular organisms need specialised exchange surfaces.
6. Explain how the lungs are adapted for efficient diffusion.

4.1.3.2 Osmosis

1. What is osmosis?
2. Through what type of membrane does osmosis occur?
3. In which direction does water move during osmosis?
4. Explain what happens to a plant cell placed in a very dilute solution.
5. Explain what happens to a plant cell placed in a concentrated sugar solution.
6. Explain the difference between diffusion and osmosis.

Required Practical 2: Osmosis

1. Which plant tissue is commonly used in the osmosis required practical?
2. In the potato osmosis required practical, which variable is deliberately changed?
3. In the potato osmosis required practical, what measurement is recorded before and after placing the potato cylinders in solution?

4. Why should all potato cylinders be cut to the same size in the potato osmosis required practical?
5. Explain why the mass of potato cylinders changes when they are placed in different sugar solutions.
6. Explain how the results of the potato osmosis required practical can be used to estimate the concentration of the potato cells.

4.1.3.3 Active Transport

1. What is active transport?
2. In which direction do substances move during active transport?
3. Why does active transport require energy?
4. Give one example of where active transport occurs in plants.
5. Give one example of where active transport occurs in humans.
6. Explain two differences between diffusion and active transport.

Topic 2: Organisation

4.2.1 Principles of Organisation

1. What is a cell?
2. What is a tissue?
3. What is an organ?
4. What is an organ system?
5. Put these in order from smallest to largest: organ, organism, tissue, cell, organ system.
6. Explain how cells are organised to form an organism.

4.2.2.1 The Human Digestive System

1. What is the main function of the digestive system?
2. Where does digestion begin in the human body?
3. Name the organ where most absorption of digested food occurs.
4. State the role of the small intestine in digestion and absorption.
5. Explain why digestion produces small soluble molecules.
6. Explain how the digestive system and circulatory system work together.

Enzymes and Metabolism

1. What type of biological molecule are enzymes?
2. What is the function of enzymes?

3. What is the active site of an enzyme?
4. Explain why enzymes are specific to their substrates.
5. Describe the lock and key model of enzyme action.
6. Explain why changes in temperature can affect enzyme activity.

Digestive Enzymes

1. Which enzyme breaks down starch?
2. Which enzyme breaks down proteins?
3. Which enzyme breaks down lipids?
4. What are the products of protein digestion?
5. What are the products of lipid digestion?
6. Explain why the products of digestion can be absorbed into the bloodstream.

Bile

1. Where is bile produced?
2. Where is bile stored?
3. What is the role of bile in digestion?
4. Why does bile neutralise stomach acid?
5. Explain how bile increases the rate of fat digestion.
6. Explain why lipase works more effectively after bile has acted on fats.

Required Practical – Food Tests

1. What reagent is used to test for reducing sugars?
2. Describe the method and positive result for the test for reducing sugars.
3. What reagent is used to test for starch, and what is the positive result?
4. What reagent is used to test for protein, and what is the positive result?
5. Describe the method and positive result for the test for lipids.
6. Why should clean test tubes and equal sample volumes be used in food tests?

4.2.2.2 The Heart and Blood Vessels

1. What is the main function of the heart?
2. What type of circulatory system do humans have?
3. Which side of the heart pumps blood to the lungs?

4. Which side of the heart pumps blood around the body?
5. Name the five main blood vessels associated with the heart.
6. Explain why the heart is described as a double circulatory system.

Structure of the Heart

7. Which organ pumps blood around the body?
8. What is the function of the ventricles?
9. What is the function of the atria?
10. Why is the left ventricle thicker than the right ventricle?
11. Explain why the heart muscle needs its own blood supply.
12. Explain the role of the natural pacemaker and state where it is found.

The Lungs and Gas Exchange

1. What gas enters the blood in the lungs?
2. What gas leaves the blood in the lungs?
3. What structure in the lungs is adapted for gas exchange?
4. Name the blood vessels surrounding alveoli.
5. Explain how alveoli are adapted for gas exchange.
6. Explain why a good blood supply increases the efficiency of gas exchange.

Blood Vessels

1. Name the three types of blood vessel.
2. Which blood vessel carries blood away from the heart?
3. Which blood vessel carries blood towards the heart?
4. Explain why arteries have thick muscular walls.
5. Explain why capillaries have thin walls.
6. Compare the structures of arteries, veins and capillaries.

4.2.2.3 Blood

1. What is plasma?
2. What is the function of red blood cells?
3. What is the function of white blood cells?
4. What is the function of platelets?
5. Explain how red blood cells are adapted to their function.
6. Explain why blood is described as a tissue.

4.2.2.4 Coronary Heart Disease

1. What causes coronary heart disease?
2. Why is reduced blood flow to the heart dangerous?
3. What is the function of a stent?
4. What do statins do?
5. What is the difference between a biological valve and a mechanical valve?
6. Evaluate the advantages and disadvantages of heart transplants and artificial hearts.

4.2.2.5 Health Issues

1. What is health?
2. What is the difference between a communicable and a non-communicable disease?
3. Give two factors other than disease that affect health.
4. How can a weakened immune system affect health?
5. Explain how viruses can increase the risk of cancer.
6. Explain how different diseases can interact with one another.

4.2.2.6 Effect of Lifestyle on Non-Communicable Diseases

1. What is a risk factor?
2. How does smoking affect the lungs?
3. How does alcohol affect the liver?
4. Why is obesity a risk factor for Type 2 diabetes?
5. How can smoking affect an unborn baby?
6. Explain why many non-communicable diseases have more than one risk factor.

4.2.2.7 Cancer

1. What is a tumour?
2. What is a benign tumour?
3. What is a malignant tumour?
4. How do malignant tumours spread around the body?
5. Give one lifestyle risk factor for cancer.
6. Compare benign and malignant tumours.

4.2.3.1 Plant Tissues

1. What is the function of epidermal tissue?
2. What is the function of palisade mesophyll cells?
3. What is the function of spongy mesophyll?
4. What is the function of xylem tissue?
5. What is the function of phloem tissue?
6. Explain why meristem tissue is important for plant growth.

4.2.3.2 Plant Organ System

1. What is transpiration?
2. What is translocation?
3. How are root hair cells adapted for absorbing water?
4. How is xylem adapted for transporting water?
5. What is the role of guard cells?
6. Explain how temperature, light intensity, humidity and wind speed affect the rate of transpiration.

Topic 3: Infection and Response

4.3.1.1 Communicable (Infectious) Diseases

1. What is a pathogen?
2. Name the four types of pathogen.
3. Give three ways pathogens can spread.
4. How do bacteria make us ill?
5. How do viruses cause disease?
6. Explain how the spread of communicable diseases can be reduced.

4.3.1.2 Viral Diseases

1. What type of pathogen causes measles?
2. How is measles spread?
3. Why are children vaccinated against measles?
4. How is HIV spread?

5. How does HIV damage the body?
6. Explain how tobacco mosaic virus affects plant growth.

4.3.1.3 Bacterial Diseases

1. What type of pathogen causes salmonella?
2. How is salmonella spread?
3. Name two symptoms of salmonella food poisoning.
4. How is salmonella controlled in UK poultry?
5. How is gonorrhoea spread?
6. Explain why gonorrhoea has become more difficult to treat.

4.3.1.4 Fungal Diseases

1. Which fungus causes rose black spot?
2. What are the symptoms of rose black spot?
3. How is rose black spot spread?
4. Why does rose black spot reduce plant growth?
5. How can rose black spot be treated?
6. Explain why removing infected leaves helps control the disease.

4.3.1.5 Protist Diseases

1. What type of pathogen causes malaria?
2. Which organism carries malaria?
3. Name one symptom of malaria.
4. Why is the mosquito called a vector?
5. How can mosquito nets reduce malaria?
6. Explain two methods used to control the spread of malaria.

4.3.1.6 Human Defence Systems

1. How does the skin help prevent infection?
2. How does the nose help stop pathogens entering the body?
3. What is the function of mucus in the trachea and bronchi?
4. How does stomach acid protect the body?
5. Name the three ways white blood cells defend the body.
6. Explain the roles of phagocytosis, antibodies and antitoxins in defending against disease.

4.3.1.7 Vaccination

1. What is a vaccine?
2. What does a vaccine contain?
3. Why are vaccines given before a person catches a disease?
4. How do white blood cells respond after vaccination?
5. Why does vaccination usually provide long-term protection?
6. Explain how vaccinating a large proportion of the population reduces the spread of disease.

4.3.1.8 Antibiotics and Painkillers

1. What are antibiotics used to treat?
2. Give one example of an antibiotic.
3. Why can't antibiotics treat viral diseases?
4. What do painkillers do?
5. What is antibiotic resistance?
6. Explain why antibiotic-resistant bacteria are a serious problem.

4.3.1.9 Discovery and Development of Drugs

1. Which plant is the source of aspirin?
2. Which plant is the source of digitalis?
3. Who discovered penicillin?
4. What is tested during preclinical drug testing?
5. Why are double-blind clinical trials used?
6. Explain why new drugs must be tested for toxicity, efficacy and optimum dose before they are approved.

Topic 4: Bioenergetics

4.4.1.1 Photosynthetic Reaction

1. What is photosynthesis?
2. What are the two reactants in photosynthesis?
3. What are the two products of photosynthesis?
4. In which organelle does photosynthesis take place?
5. Why is photosynthesis described as an endothermic reaction?
6. Write the word equation for photosynthesis.

4.4.1.2 Rate of Photosynthesis

1. Name four factors that affect the rate of photosynthesis.
2. What is meant by a limiting factor?
3. How does increasing light intensity affect the rate of photosynthesis?
4. How does increasing carbon dioxide concentration affect photosynthesis?
5. Explain how temperature affects the rate of photosynthesis.
6. Explain how growers use limiting factors to increase crop yield in greenhouses.

4.4.1.3 Uses of Glucose from Photosynthesis

1. What process uses glucose to release energy?
2. Why is glucose converted into starch?
3. How is glucose used to make cellulose?
4. How is glucose used to produce fats and oils?
5. What else do plants need, as well as glucose, to make proteins?
6. Explain five different uses of glucose made during photosynthesis.

4.4.2.1 Aerobic and Anaerobic Respiration

1. What is respiration?
2. What type of reaction is respiration?
3. What is the word equation for aerobic respiration?
4. What is the word equation for anaerobic respiration in muscles?
5. What are the products of anaerobic respiration in yeast?
6. Compare aerobic and anaerobic respiration in terms of oxygen required, products and energy released.

4.4.2.2 Response to Exercise

1. What happens to heart rate during exercise?
2. What happens to breathing rate during exercise?
3. Why do muscles carry out anaerobic respiration during vigorous exercise?
4. What causes muscles to become fatigued?
5. What is oxygen debt?
6. Explain how the body removes lactic acid after exercise.

4.4.2.3 Metabolism

1. What is metabolism?
2. What process provides the energy needed for metabolism?
3. What is glucose converted into for storage in animals?
4. What is glucose converted into for storage in plants?

5. How are amino acids used in metabolism?
6. Describe the main reactions that are part of metabolism.

Paper 2:

Topic 5: Homeostasis and Response

4.5.1 Homeostasis

1. What is homeostasis?
2. Name three conditions controlled by homeostasis.
3. What is a receptor?
4. What is an effector?
5. Name three coordination centres in the body.
6. Explain how receptors, coordination centres and effectors work together to maintain homeostasis.

4.5.2 The Human Nervous System

1. What is the function of the nervous system?
2. What does CNS stand for?
3. Which two organs make up the central nervous system?
4. Put these in order: stimulus, receptor, coordinator, effector, response.
5. What is a reflex action?
6. Explain how a reflex arc produces a rapid response.

4.5.3.1 Human Endocrine System

1. What is a hormone?
2. What is the endocrine system?
3. How are hormones transported around the body?
4. Why is the pituitary gland called the "master gland"?

5. State one difference between the endocrine system and the nervous system.
6. Compare hormonal coordination with nervous coordination.

4.5.3.2 Control of Blood Glucose Concentration

1. Which organ monitors blood glucose concentration?
2. Which hormone lowers blood glucose concentration?
3. What is glycogen?
4. What causes Type 1 diabetes?
5. How is Type 2 diabetes commonly treated?
6. Compare Type 1 and Type 2 diabetes.

4.5.3.3 Hormones in Human Reproduction

1. Which hormone is the main female reproductive hormone?
2. Which hormone is the main male reproductive hormone?
3. What is ovulation?
4. What is the function of FSH?
5. What is the function of LH?
6. Explain the roles of FSH, LH, oestrogen and progesterone in the menstrual cycle.

4.5.3.4 Contraception

1. What is contraception?
2. Give one hormonal method of contraception.
3. Give one non-hormonal method of contraception.
4. How does the contraceptive pill prevent pregnancy?
5. How do condoms prevent pregnancy?
6. Compare hormonal and non-hormonal methods of contraception.

4.5.3.5 The Use of Hormones to Treat Infertility (HT)

1. What is infertility?
2. Which two hormones are used in fertility drugs?
3. What does IVF stand for?
4. Why are FSH and LH given before IVF?
5. Describe the main stages of IVF treatment.
6. Evaluate the advantages and disadvantages of IVF.

4.5.3.6 Feedback Systems (HT)

1. Which gland produces adrenaline?
2. Which gland produces thyroxine?
3. What is the function of adrenaline?
4. What is the function of thyroxine?
5. What is negative feedback?
6. Explain how negative feedback helps control thyroxine levels.

Topic 6: Inheritance, Variation and Evolution

4.6.1.1 Sexual and Asexual Reproduction

1. What is sexual reproduction?
2. What is asexual reproduction?
3. Which type of cell division produces gametes?
4. Which type of cell division produces genetically identical cells?
5. Why does sexual reproduction produce variation?
6. Compare sexual and asexual reproduction.

4.6.1.2 Meiosis

1. What is meiosis?
2. Where does meiosis take place?
3. How many gametes are produced from one cell?
4. Why are gametes genetically different?
5. What happens to chromosome number during meiosis and fertilisation?
6. Explain how meiosis and fertilisation produce variation.

4.6.1.3 DNA and the Genome

1. What does DNA stand for?
2. What is a chromosome?
3. What is a gene?
4. What is a genome?

5. What does a gene code for?
6. Give three benefits of understanding the human genome.

4.6.1.4 Genetic Inheritance

1. What is an allele?
2. What is the difference between dominant and recessive alleles?
3. What is meant by homozygous?
4. What is meant by heterozygous?
5. What is the difference between genotype and phenotype?
6. Complete and interpret a simple Punnett square for a single gene cross.

4.6.1.5 Inherited Disorders

1. What is an inherited disorder?
2. Which inherited disorder is caused by a dominant allele?
3. Which inherited disorder is caused by a recessive allele?
4. What is polydactyly?
5. What is cystic fibrosis?
6. Explain the ethical issues surrounding embryo screening.

4.6.1.6 Sex Determination

1. How many pairs of chromosomes do humans have?
2. What are the female sex chromosomes?
3. What are the male sex chromosomes?
4. Which parent determines the sex of a baby?
5. What is the probability of having a male child?
6. Complete a genetic cross for sex determination.

4.6.2.1 Variation

1. What is variation?
2. Name two causes of variation.
3. What is a mutation?
4. Do most mutations affect phenotype?
5. How can environmental factors affect phenotype?
6. Explain how mutations can lead to evolution.

4.6.2.2 Evolution

1. What is evolution?

2. What is natural selection?
3. Why are some organisms more likely to survive and reproduce?
4. How can a new species form?
5. What is meant by "survival of the fittest"?
6. Explain evolution by natural selection.

4.6.2.3 Selective Breeding

1. What is selective breeding?
2. Why do humans selectively breed plants and animals?
3. Give one example of selective breeding.
4. How is selective breeding carried out?
5. Give one disadvantage of selective breeding.
6. Evaluate the advantages and disadvantages of selective breeding.

4.6.2.4 Genetic Engineering

1. What is genetic engineering?
2. What is a genetically modified (GM) crop?
3. Give one medical use of genetic engineering.
4. Give one agricultural use of genetic engineering.
5. Give one advantage and one disadvantage of GM crops.
6. Explain how genetic engineering can benefit medicine and agriculture.

4.6.3.1 Evidence for Evolution

1. Who proposed the theory of evolution by natural selection?
2. Name two pieces of evidence for evolution.
3. How do fossils provide evidence for evolution?
4. How does antibiotic resistance support evolution?
5. Why is evolution widely accepted today?
6. Explain how evidence supports the theory of evolution.

4.6.3.2 Fossils

1. What is a fossil?
2. Give one way fossils can form.
3. Why is the fossil record incomplete?
4. What can scientists learn from fossils?
5. Why are there few fossils of early soft-bodied organisms?
6. Explain why fossils are important evidence for evolution.

4.6.3.3 Extinction

1. What is extinction?
2. What does it mean if a species is extinct?
3. Give one cause of extinction.
4. How can environmental change lead to extinction?
5. How can competition contribute to extinction?
6. Explain why species become extinct.

4.6.3.4 Resistant Bacteria

1. What is antibiotic resistance?
2. Why do bacteria evolve quickly?
3. What is MRSA?
4. Why should antibiotics not be prescribed for viral infections?
5. Why should patients finish their course of antibiotics?
6. Explain how antibiotic-resistant bacteria evolve.

4.6.4 Classification of Living Organisms

1. Who developed the traditional classification system?
2. What is binomial naming?
3. List the seven taxonomic groups in order.
4. Who developed the three-domain system?
5. Name the three domains.
6. Explain why classification systems have changed over time.

Topic 7: Ecology

4.7.1.1 Communities

1. What is an ecosystem?
2. What is a community?
3. Put these in order: organism, population, community, ecosystem.
4. What is meant by interdependence?
5. What do plants compete for?

6. Explain why removing one species can affect the whole community.

4.7.1.2 Abiotic Factors

1. What is an abiotic factor?
2. Name four abiotic factors.
3. How does light intensity affect plants?
4. Why is soil pH important for plants?
5. Why are oxygen levels important for aquatic animals?
6. Explain how a change in one abiotic factor can affect a community.

4.7.1.3 Biotic Factors

1. What is a biotic factor?
2. Name four biotic factors.
3. How does food availability affect populations?
4. How can a new predator affect a community?
5. What happens if one species outcompetes another?
6. Explain how changes in biotic factors affect ecosystems.

4.7.1.4 Adaptations

1. What is an adaptation?
2. Name the three types of adaptation.
3. What is a structural adaptation?
4. What is a behavioural adaptation?
5. What is a functional adaptation?
6. Explain why extremophiles are able to survive in extreme environments.

4.7.2.1 Levels of Organisation

1. What is a producer?
2. What is a primary consumer?
3. What is a predator?
4. What is prey?
5. Which sampling methods are used to estimate population size?
6. Explain why predator and prey populations rise and fall in cycles.

4.7.2.2 How Materials are Cycled

1. Name the two cycles studied in ecology.
2. Why are materials recycled?

3. What process returns carbon dioxide to the atmosphere?
4. What process removes carbon dioxide from the atmosphere?
5. What is the role of microorganisms in the carbon cycle?
6. Explain the importance of the carbon and water cycles.

4.7.3.1 Biodiversity

1. What is biodiversity?
2. Why is biodiversity important?
3. Name one human activity that reduces biodiversity.
4. How does biodiversity help keep ecosystems stable?
5. Why is biodiversity important for humans?
6. Explain how human activities reduce biodiversity.

4.7.3.2 Waste Management

1. Name three types of pollution.
2. How can sewage pollute water?
3. How can air pollution be caused?
4. How does landfill affect the environment?
5. How does pollution affect biodiversity?
6. Explain why increasing human population leads to more pollution.

4.7.3.3 Land Use

1. Name four ways humans use land.
2. What is a peat bog?
3. Why are peat bogs important?
4. What happens when peat is burned?
5. How does destroying peat bogs reduce biodiversity?
6. Explain the conflict between using peat for compost and conserving peat bogs.

4.7.3.4 Deforestation

1. What is deforestation?
2. Give two reasons for deforestation.
3. Why are forests cleared for cattle farming?
4. Why are forests cleared to grow biofuel crops?
5. How does deforestation reduce biodiversity?
6. Explain the environmental impacts of deforestation.

4.7.3.5 Global Warming

1. Name two greenhouse gases.
2. What is global warming?
3. How does carbon dioxide contribute to global warming?
4. Name one biological consequence of global warming.
5. How can global warming affect species distribution?
6. Explain how increasing greenhouse gases can affect ecosystems.

4.7.3.6 Maintaining Biodiversity

1. What is a breeding programme?
2. Why are rare habitats protected?
3. Why are hedgerows and field margins important?
4. How does recycling help biodiversity?
5. How can reducing deforestation protect biodiversity?
6. Explain how humans can maintain biodiversity.