Biology (S5 - S6)

1 Introduction

Biology is a branch of science devoted to the study of living things. At HKUGAC, the study of biology aims to help students in understanding the nature of life and appreciate the wonders of the living world. Through providing biology-related learning experiences, students are fostered to develop scientific literacy, so that they can participate actively in our rapidly changing knowledge-based society, prepare for further studies or careers in the fields related to life science, and become lifelong learners in science and technology. In addition, students are being prepared to sit for the International Advanced Subsidiary/ Advanced Level examination in biology in S5 and S6.

1.1 Teaching methods

Appropriate learning and teaching approaches will be adopted by teachers to meet the different learning targets and outcomes of individual lessons, as well as the varied need and learning styles of our students.

1.1.1 Contextual approach

Inquiry activities that link biology to technological applications, societal issues and students' daily experiences will be given to enable students to acquire the relevant concepts, skills and attitudes in a step-wise manner.

1.1.2 Practical work and scientific investigation

As biology is a practical subject, students are guided to gain personal experience of science through hands-on practical activities, and to develop the skills and scientific thinking with the processes of problem-solving, decision-making and evaluation of evidence.

1.1.3 Problem-based learning

Students are challenged to solve real problems by applying thinking skills and working cooperatively in a group. Students are fostered with the skills to find and use appropriate learning resources, and to think critically and analytically. In this approach, students actively engage in the learning process and allow them to take responsibility for their own learning, training to become lifelong learners.

1.1.4 E-learning

E-learning has been implemented in the curriculum of Biology. It is broadly inclusive of different forms of educational technology in learning and teaching, such as multimedia learning, computer-aided instruction, internet-based training, web-based training, online education, virtual education, etc. E-learning is a valuable way for interactive learning which complements strategies for learning both inside and outside the classroom.

Through computer animations or simulations, students can visualize abstract concepts and processes. It also allows students to work at their own pace, and gives them more time to pursue creative activities. In addition, e-learning may extend students' learning through the internet, which is an extremely valuable source of scientific information and resources. The internet may also provide opportunities for students to learn, sometimes collaboratively, with students in another part of the world. Through the use of electronic media, we aim to provide students with an enriched and more efficient learning environment,

enhance self-directed learning and meet their varied learning needs – and to gradually become lifelong learners.

1.2 Assessment

Internal assessment will be carried out from S5 to S6. Both formative and summative assessments will be used in promoting learning and monitoring students' progress. Formative assessment is carried out in various ways including within practical work, projects, oral presentation, class discussions, assignments and written quizzes and tests. Summative assessment takes place at the end of each term to review the standard of achievement reached by each student.

2 Aims and objectives

The curriculum is designed to enable students to:

1. develop and maintain an interest in biology, a sense of wonder and curiosity about the living world, and a respect for all living things and the environment;
2. construct and apply knowledge of biology, understand the nature of science, and appreciate the relationships between biological science and other disciplines;
3. develop skills in carrying out scientific investigations individually and collaboratively;
4. be aware of the social, ethical, economic, environmental and technology implications of biology, and be able to make informed decisions and judgments on biology-related issues;
5. develop an attitude of responsible citizenship, and a commitment to promote personal and community health.
6. develop transferable skills in cognitive, intrapersonal and interpersonal aspects.

3 Curriculum

The curriculum is based on the International Advanced Subsidiary (IAS)/International Advanced Level (IAL) and emphasizes to strengthen students' understanding of:

1. the nature of scientific inquiry in biology;
2. the interconnections between science, technology, society and the environment;
3. biology as a dynamic body of knowledge and is a human endeavour.

3.1 Curriculum framework

		Topics
Compulsory Part	**S5**	<u>Revision of S4 topics</u> Students should be able to: ● Recognize the scientific methods to study biology ● Describe the significance of organic and inorganic substances to life ● Test for the biomolecules using chemical tests ● Appreciate the contribution of the technological development of the microscope to the discovery and the understanding of cells and organelles ● Describe and appreciate the levels of organization in multicellular organisms ● Distinguish among the different types of transport processes and their essence to cell functioning ● Distinguish between catabolic and anabolic processes ● Recognize the properties of enzyme and its roles in metabolism and everyday life application ● Describe how substances are being transported across a membrane ● Describe how gas exchange takes place in human breathing system ● Recognize the purpose of having a circulatory system in human ● Identify the constituents and the functions of the lymphatic system ● Identify the causes and health issues with human transport system
		<u>Cell Structure</u> Student should be able to: ● Recognize all living organisms are made of cells, sharing some common features ● Understand how the cells of multicellular organisms are organised into tissues, tissues into organs and organs into organ systems ● Identify the ultrastructure of eukaryotic cells, including nucleus, nucleolus, ribosomes, rough and smooth endoplasmic reticulum, mitochondria, centrioles, lysosomes and Golgi apparatus, and state the function of these organelles ● The ultrastructure of prokaryotic cells, including cell wall, capsule, plasmid, flagellum, pili, ribosomes and circular DNA, and the function of these structures
		<u>Mitosis, meiosis and reproduction</u> Student should be able to: ● Understand the linkage of genes on a chromosome ● Explain the significance of mitosis and its cell cycle ● Explain the significance of meiosis and its cell cycle ● Explain how gametes are specialized for their functions ● Outline the process of fertilization in mammals (cortical reaction) and flowering plants

		Development of organisms Student should be able to: ◆ Explain how cells become specialized through differential gene expression, producing active mRNA, leading to the synthesis of proteins which, in turn, control cell processes or determine cell structure in animals and plants ◆ Suggest how one gene can give rise to more than one protein through post-transcriptional changes to messenger RNA (mRNA) ◆ Explain how epigenetic modification, including DNA methylation and histone modification, can alter the activation of certain genes ◆ Outline how epigenetic modifications can be passed on following cell division, how some phenotypes are affected by multiple alleles for the same gene, or by polygenic inheritance, as well as the environment, and how polygenic inheritance can give rise to phenotypes that show continuous variation
		Plant structure and function Student should be able to: ◆ Recognize the structure and ultrastructure of plant cells including cell wall, chloroplast, amyloplast, vacuole, tonoplast, plasmodesmata, pits and middle lamella and compare it with animal cells ◆ Explain the structure and function of the polysaccharides starch and cellulose, including the role of hydrogen bonds between the β-glucose molecules in the formation of cellulose microfibrils ◆ Explain how the arrangement of cellulose microfibrils and secondary thickening in plant cell walls contributes to the physical properties of xylem vessels and sclerenchyma fibres in plant fibres that can be exploited by humans ◆ State the similarities and differences between the structures of, the position in the stem, and the function of sclerenchyma fibres (support), xylem vessels (support and transport of water and mineral ions) and phloem (translocation of organic solutes) ◆ Describe how the uses of plant fibres and starch may contribute to sustainability, including plant-based products to replace oil-based plastics
		Classification Student should be able to: ◆ Recognize that classification is a means of organizing the variety of life based on relationships between organisms using differences and similarities in phenotypes and in genotypes, and is built around the species concept ◆ Understand the process and importance of critical evaluation of new data by the scientific community leading to new taxonomic groupings, based on molecular evidence, including the three-domain system (Archaea, Bacteria and Eukarya) ◆ Realize over time, the variety of life has become extensive but is now being threatened by human activity ◆ Understand how biodiversity can be measured within a habitat using species richness, and within a species using genetic diversity by calculating the heterozygosity index

		Biodiversity and Conservation Student should be able to: ◆ Understand how the Hardy-Weinberg equation can be used to see whether a change in allele frequency is occurring in a population over time ◆ Understand changes in allele frequency can come about as a result of mutation and natural selection ◆ Explain reproductive isolation can lead to accumulation of different genetic information in populations, potentially leading to the formation of new species, the methods used by zoos and seed banks in the conservation of endangered species and their genetic diversity, including scientific research, captive breeding programmes, reintroduction programmes and education
		Photosynthesis Student should be able to: ♦ State the overall reaction of photosynthesis, requiring energy from light to split apart the strong bonds in water molecules, storing the hydrogen in a fuel (glucose) by combining it with carbon dioxide and releasing oxygen into the atmosphere ♦ Recognize how photophosphorylation of ADP requires energy and that hydrolysis of ATP provides an immediate supply of energy for biological processes ♦ Outline the light-dependent reactions of photosynthesis, including how light energy is trapped by exciting electrons in chlorophyll and the role of these electrons in generating ATP, reducing NADP in cyclic and non-cyclic photophosphorylation and producing oxygen through photolysis of water
		Ecology Student should be able to: ♦ Find the relationship between gross primary productivity (GPP), net primary productivity (NPP) and plant respiration (R) ♦ Calculate net primary productivity ♦ Calculate the efficiency of biomass and energy transfers between trophic levels ♦ Define the terms *population*, *community*, *habitat* and *ecosystem* ♦ Suggest the numbers and distribution of organisms in a habitat are controlled by biotic and abiotic factors ♦ Relate how the concept of niche accounts for the distribution and abundance of organisms in a habitat

		Environment And Climate Change Student should be able to: ♦ Outline the stages of succession from colonization to the formation of a climax community the stages of succession from ♦ Suggest the different types of evidence for climate change and its causes, including records of carbon dioxide levels, temperature records, pollen in peat bogs and dendrochronology, ♦ Recognize correlations and causal relationships ♦ Find the causes of anthropogenic climate change, including the role of greenhouse gases in the greenhouse effect ♦ Apply knowledge of the carbon cycle to methods in reducing atmospheric levels of carbon dioxide ♦ Extrapolate data to make predictions and that these are used in models of future climate change ♦ Realize the limitations of models for climate change ♦ Suggest the effects of climate change (changing rainfall patterns and changes in seasonal cycles) on plants and animals (distribution of species, development and lifecycles) ♦ Suggest the effect of temperature on the rate of enzyme activity and its impact on plants, animals and microorganisms, to include Q_{10} ♦ Describe how evolution (a change in allele frequency) can come about through gene mutation and natural selection ♦ Outline how isolation reduces gene flow between populations, leading to allopatric or sympatric speciation ♦ Discuss the way in which scientific conclusions about controversial issues, such as what actions should be taken to reduce climate change, or the degree to which humans are affecting climate change, can sometimes depend on who is reaching the conclusions ♦ Discuss how reforestation and the use of sustainable resources, including biofuels, are examples of the effective management of the conflict between human needs and conservation
		Microbiology Student should be able to: ♦ Outline the principles and techniques involved in culturing microorganisms, using aseptic technique ♦ Compare the different methods of measuring the growth of microorganisms, as illustrated by cell counts, dilution plating, mass and optical methods (turbidity) ♦ Describe the different phases of a bacterial growth curve (lag phase, exponential phase, stationary phase and death phase) ♦ Calculate exponential growth rate constants

		Immunity Student should be able to: ♦ Compare the structure of bacteria and viruses (nucleic acid, capsid structure and envelope) with reference to Ebola virus, tobacco mosaic virus (TMV), human immunodeficiency virus (HIV) and lambda phage (λ phage) ♦ Define the terms *lytic* and *latency* ♦ Describe how *Mycobacterium tuberculosis* and human immunodeficiency virus (HIV) infect human cells, causing symptoms that may result in death ♦ Outline the major routes pathogens may take when entering the body ♦ Describe the role of barriers in protecting the body from infection, including skin, stomach acid, and gut and skin flora ♦ Outline the non-specific responses of the body to infection, including inflammation, lysozyme action, interferon and phagocytosis ♦ Describe the roles of antigens and antibodies in the body's immune response including the involvement of plasma cells, macrophages and antigen-presenting cells ♦ Compare the differences between the roles of B cells (B memory and B effector cells), and T cells (T helper, T killer and T memory cells) in the host's immune response ♦ Describe how individuals may develop immunity (natural, artificial, active and passive) ♦ Discuss how the theory of an 'evolutionary race' between pathogens and their hosts is supported by evasion mechanisms shown by pathogens ♦ Compare the difference between bacteriostatic and bactericidal antibiotics ♦ Suggest how an understanding of the contributory causes of hospital- acquired infections has led to codes of practice regarding antibiotic prescription and hospital practice that relate to infection prevention and control
		Decomposition and forensics Student should be able to: ♦ Discuss the role of microorganisms in the decomposition of organic matter and the recycling of carbon ♦ Describe how DNA can be amplified using the polymerase chain reaction (PCR) ♦ Describe how gel electrophoresis can be used to separate DNA fragments of different length ♦ Explain how DNA profiling is used for identification and determining genetic relationships between organisms (plants and animals) ♦ Explain how to determine the time of death of a mammal by examining the extent of decomposition, stage of succession, forensic entomology, body temperature and degree of muscle contraction

Compulsory Part		Cellular Respiration Students should be able to: ● understand the overall reaction of aerobic respiration as splitting of the respiratory substrate to release carbon dioxide as a waste product and reuniting hydrogen with atmospheric oxygen with the release of large amounts of energy ● understand that respiration is a stepped process, with each step controlled and catalyzed by a specific intracellular enzyme ● understand the roles of glycolysis in aerobic and anaerobic respiration, including the phosphorylation of hexoses, the production of ATP by substrate level phosphorylation, reduced coenzyme, pyruvate and lactate ● understand the role of the link reaction and the Krebs cycle in the complete oxidation of glucose and formation of carbon dioxide (CO_2) by decarboxylation, ATP by substrate level phosphorylation, reduced NAD and reduced FAD by dehydrogenation (names of other compounds are not required) and that these steps take place in mitochondria, unlike glycolysis which occurs in the cytoplasm ● understand how ATP is synthesized by oxidative phosphorylation associated with the electron transport chain in mitochondria, including the role of chemiosmosis and ATP synthase ● understand what happens to lactate after a period of anaerobic respiration in animals ● understand what is meant by the term *respiratory quotient* (*RQ*)
	S6	Muscles, movement and the heart: Students should be able to: ● Know the way in which muscles, tendons, the skeleton and ligaments interact to enable movement, including antagonistic muscle pairs, extensors and flexors ● Know the structure of a mammalian skeletal muscle fibre ● Understand the structural and physiological differences between fast and slow twitch muscle fibres ● Understand the process of contraction of skeletal muscle in terms of the sliding filament theory, including the role of actin, myosin, troponin, tropomyosin, calcium ions (ca2+), ATP and ATPase ● Know the myogenic nature of cardiac muscle ● Understand how the normal electrical activity of the heart coordinates the heartbeat, including the roles of the sinoatrial node (SAN), the atrioventricular node (AVN), the bundle of his and the Purkinje fibres ● Understand how the use of electrocardiograms (ECGS) can aid in the diagnosis of abnormal heart rhythms ● Calculate cardiac output ● Understand how variations in ventilation and cardiac output enable rapid delivery of oxygen to tissues and the removal of carbon dioxide from them, including how the heart rate and ventilation rate are controlled and the roles of the cardiovascular control centre and the ventilation centre in the medulla oblongata ● Understand the role of adrenaline in the fight or flight response

		<u>Control of the internal environment</u> Students should be able to: ● Understand what is meant by the terms *negative feedback* and *positive feedback control* ● Understand the principle of negative feedback in maintaining systems within narrow limits ● Understand what is meant by the term *homeostasis* and its importance in maintaining the body in a state of dynamic equilibrium during exercise, including the role of the hypothalamus in thermoregulation ● Know the gross and microscopic structure of the mammalian kidney ● Understand how urea is produced in the liver from excess amino acids (*details of the ornithine cycle are not required*) and how it is removed from the bloodstream by ultrafiltration ● Understand how solutes are selectively reabsorbed in the proximal tubule and how the loop of Henle acts as a countercurrent multiplier to increase the reabsorption of water ● Understand how the pituitary gland and osmoreceptors in the hypothalamus, combined with the action of antidiuretic hormone (ADH), bring about negative feedback control of mammalian plasma concentration and blood volume ● Understand how genes can be switched on and off by DNA transcription factors, including the role of peptide hormones acting extracellularly and steroid hormones acting intracellularly
		<u>The nervous system and neurones</u> Students should be able to: ● Know the structure and function of sensory, relay and motor neurones, including Schwann cells and myelination ● Understand how the nervous system of organisms can cause effectors to respond to a stimulus ● Know the structure and function of a spinal reflex arc, including grey matter and white matter of the spinal cord ● Understand how a nerve impulse (action potential) is conducted along an axon, including changes in membrane permeability to sodium and potassium ions ● Understand the role of myelination in saltatory conduction ● Know the structure and function of synapses in nerve impulse transmission, including the role of neurotransmitters and acetylcholine ● Understand how the pupil dilates and contracts ● Understand how the effects of drugs can be caused by their influence on nerve impulse transmission, illustrated by nicotine, lidocaine and cobra venom alpha toxin, the use of L-DOPA in the treatment of Parkinson's disease and the action of MDMA (ecstasy) ● Understand how the nervous systems of organisms can detect stimuli with reference to rods in the retina of mammals, the roles of rhodopsin, opsin, retinal, sodium ions, cation channels and hyperpolarisation of rod cells in forming action potentials in the optic neurones ● Understand what is meant by the term habituation

		Coordination in animals and plants ● Know that the mammalian nervous system consists of the central and peripheral nervous systems ● Understand how phytochrome, auxin (IAA) and gibberellins bring about responses in plants, including their effects on transcription ● Understand how coordination in animals is brought about through nervous and hormonal control ● Know the location and main functions of the cerebral hemispheres, hypothalamus, pituitary gland, cerebellum and medulla oblongata of the human brain ● Understand how magnetic resonance imaging (MRI), functional magnetic resonance imaging (fMRI), positron emission tomography (PET) and computed tomography (CT) are used in medical diagnosis and the investigation of brain structure and function ● Understand how imbalances in certain naturally occurring brain chemicals can contribute to ill health, including dopamine in Parkinson's disease and serotonin in depression, and to the development of new drugs ● Know how drugs can be produced using genetically modified organisms (plants, animals and microorganisms)
		Gene technology Students should be able to: ● understand how recombinant DNA can be produced, including the roles of restriction endonucleases and DNA ligase ● understand how recombinant DNA can be inserted into other cells ● know how microarrays can be used to identify active genes ● understand what is meant by the term *bioinformatics* ● understand the risks and benefits associated with the use of genetically modified organisms

3.2 Delivery schedule

	S5 Biology	S6 Biology
1st Term	◆ Cytology ◆ Reproduction and development ◆ Plant structure and function	◆ Cellular Respiration ◆ Muscles, movement and the heart ◆ Control of internal environment ◆ The nervous system and neurones
2nd Term	◆ Biodiversity and Conservation ◆ Photosynthesis ◆ Ecology and the Environment ◆ Microbiology and Immunity	◆ Coordination in animals and plants ◆ Gene technology

4 Assessing students

4.1 Internal assessment in HKUGAC

4.1.1 Assessment criteria

4.1.1.1 Assessment of knowledge and understanding

Students should be able to demonstrate knowledge and understanding in relation to

1. application of concepts to familiar and unfamiliar situations;
2. application of science in society and students' everyday life;
3. analysis and evaluation of scientific information to make judgments and reach conclusions;
4. experimental skills in science, including analysis and evaluation of data and methods.

Oral questioning, class assignments, module tests and examination can be used to allow students to demonstrate their understanding and creative ideas.

4.1.1.2 Application of scientific processes

Students should be able to

1. ask relevant questions, identify problems and formulate hypotheses for investigations;
2. select and apply facts and concepts learnt to solve problems;
3. plan scientific investigations individually and collaboratively with appropriate instruments and methods;
4. collect and analyse data, make further predictions, draw conclusions and present scientific information effectively.

Project work provides excellent opportunities for students to apply what they have learnt. Investigative projects, in particular, are suitable for assessing enquiry skills such as identifying problems, formulating hypotheses and designing strategies to solve problems scientifically and creatively.

4.1.1.3 Assessment of experimental skills

Students should be able to

1. handle apparatus and chemicals safely and properly;
2. carry out instructions for experiments;
3. observe and describe objects and experimental results accurately;
4. select appropriate apparatus and suggest experimental procedures.

The most suitable methods for assessing science skills are practical assessment. Students are required to perform numbers of practical tasks. They are expected to make use of their knowledge and understanding of science in performing these tasks. Through these practical tasks, students' practical, process and generic skills will be developed and assessed.

4.1.1.4 Assessment of attitudes

Students should

1. develop curiosity and interest in science;
2. be aware of the importance of the safety of oneself and others in the laboratory and be committed to safe practices in daily life;
3. develop personal integrity through honest recording of experimental data;
4. develop an awareness of scientific advancement and its social, economic, environmental and technological implications;

5. be willing to communicate and comment on issues related to science and respect the decisions of others;
6. develop a positive attitude in enhancing personal and community health;
7. show concern for the care of the environment and a willingness to contribute to it.

Attitudes such as curiosity, perseverance, care and concern for living things, and co-operation with others are important in science learning. As these attitudes take time to develop, their assessment should take place over a period of time to show the progress that students have made. Some common means of assessing attitudes include observing behaviour, asking students to write essays, and using questionnaires.

4.1.2 Weighting of component parts

Component	Weighting
Continuous assessments ● Scientific investigations ● Experimental skills ● Quizzes and tests ● Assignments ● Preparation task before lesson	40%
Examinations	60%

4.1.3 Grading system

The performance is reported in five levels (level E to A), with A being the highest in International Advanced Subsidiary and A* being the highest in Advanced Level in Biology.

Level A	• demonstrate comprehensive knowledge and understanding of facts, concepts and principles in the Biology curriculum • apply the concepts of biology to unfamiliar situations • analyse, synthesise and critically evaluate information from multiple perspectives and in an in-depth manner • effectively communicate ideas in a succinct, logical and coherent manner with accurate use of scientific terminology and in appropriate formats • design and conduct scientific investigations, evaluate procedures, handle and analyse data collected, and draw valid conclusions
Level B	• demonstrate sound knowledge and understanding of facts, concepts and principles in the Biology curriculum • apply the concepts of biology to unfamiliar situations • analyse, synthesise and evaluate information from several perspectives • communicate ideas in a logical and coherent manner using scientific terminology and in appropriate formats • design and conduct scientific investigations, handle and interpret data collected, and draw conclusions

Level C	• demonstrate adequate knowledge and understanding of facts, concepts and principles in the Biology curriculum • apply the concepts of biology to unfamiliar situations with guidance • construct relationships and analyse information • communicate ideas in a clear, structured manner using scientific terminology and in appropriate formats • design and conduct scientific investigations, handle and interpret data collected, and draw conclusions with guidance
Level D	• demonstrate basic knowledge and understanding of facts, concepts and principles in the Biology curriculum • apply the concepts of biology to familiar situations • describe relationships and handle information • communicate ideas using appropriate scientific terms • conduct practical work by following instructions, handle and interpret data collected, and draw simple conclusions
Level E	• recall elementary facts and principles in the Biology curriculum • apply the concepts of biology to simple and familiar situations • handle simple information presented in a straightforward manner • communicate simple ideas using scientific terms • conduct simple practical work by following instructions and collect the required

5 Role of parents at home and homework

Efficient time management is essential for students to be successful in the subject. Students are encouraged to prepare each lesson based on the guided task given and bring with them questions to be asked during the lesson as a means to promote effective learning. Homework consolidates, reinforces and strengthens concepts learnt in class and helps teachers assess the performance of students. Parents are encouraged to talk to their son or daughter about the work done in class and the current learning topics in order to have a better understanding of the learning situation in the subject. Zero mark will be given to homework in late submission.

6 Guidelines for using Artificial Intelligence (AI)

Guideline on AI-assisted Learning

Artificial intelligence (AI), including Generative AI, could serve as an effective tool for assisting science learning. This section provides examples of using AI to assist learning in science and general reminders.

Examples of AI-assisted learning in science

1. **Research and organization of information**
   Information such as scientific concepts, real-life examples, and data, could be obtained from generative AI. AI could also be used to organize large amounts of information for clear presentation.

2. **Feedback**
   Generative AI could provide feedback on student work based on given criteria to improve the quality of work and assess the accuracy.

3. **Language support**
By inputting the work in generative AI, the grammar and clarity of the work could be checked.

4. **Exploration and brainstorming**
   Exploration of topics and generation of ideas for project work could be achieved using generative AI.

General reminders for using AI in science

1. **Verification of information**
   Students should assess the accuracy of scientific concepts and the reliability of examples/data with their judgment and other sources. Information obtained from generative AI may not always be correct.

2. **Learning effectiveness**
   There are multiple ways of learning. AI is not the only way for students to learn. Students should consider different learning styles and make good use of different learning strategies, instead of solely relying on AI. Moreover, information obtained from AI should be processed cognitively by students, instead of simply performing “copy and paste”.

3. **Quality of prompts**
   Prompts inputted into generative AI should be specific. More details and conditions allow responses that better suit your needs to be generated.

Guideline on ethical use of AI (Important)

General guideline

Respect Intellectual Property
Students must observe copyright laws and understand the importance of giving proper credit to the original creators of any content they use or modify. When using AI-generated text or other content, students must properly **cite the source** and **acknowledge the use of the AI tool**.

Avoid Misinformation
Students should recognize the potential dangers of AI-generated content, including the spread of **misinformation**. Students should **cross-reference** AI-generated content with reliable sources and think critically about the information's validity.

Privacy and Security
Students must be aware of **privacy** and **security** concerns when using AI tools. Students need to protect their **personal information** and use secure platforms when accessing these tools. Students should be informed about the data collection and use practices of AI tool providers and be mindful of the potential risks associated with sharing personal data.

AI policy in science
Penalty will be given to students with inappropriate use of AI in their work including assignments, projects, etc.

- Students are suggested to keep the original work before being modified by AI. The original work may be requested to be submitted to verify the originality of the submitted work.
- Mark penalty could be given for work with content generated by AI without proper citation and acknowledgment. A zero mark could be given in serious cases. Follow-ups and further disciplinary actions could be taken.
- Students may be asked to redo and resubmit their work if the AI policy is violated.

Other Reminders

- Students should consult their subject teachers for anything uncertain about the use of AI in science subjects.