# Scheme of work

## Module 2: Foundations in biology

### Topic 2.1: Foundations in biology

| Specification reference | Suggested teaching time | Delivery guide | Suggested Practical work | Notes |
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| 2.1.1 Cell Structure | 15 hours | [2.1.1 Cell Structure](https://teachcambridge.org/item/2e294f22-42b3-4124-ac27-841f79417f06) | **Experiments to allow:**   * Preparation of microscope slides * Use of differential staining to identify different cellular components and cell types * Use of light microscope to enable examinations of slides * Use of an eye piece graticule * Use of a stage micrometer * Use of photomicrograph for the production of scientific drawings with annotations   **Practical suggestions:**  [PAG1](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [RSB – A closer look at Blood](http://www.nuffieldfoundation.org/practical-biology/closer-look-blood)  [RSB - Opportunity to examine living, unstained organisms](http://www.nuffieldfoundation.org/practical-biology/observing-protoctista-water-using-hanging-drop-technique) | Suggested resources:  Interpret photomicrographs (can get from online) and use them to practice drawing skills.  Additional guidance:  To include Light microscope, TEM, and SEM; compare resolution and magnification for each.  To include identification and functions of cellular components in prokaryotes and eukaryote cells.  Maths opportunities for understanding and using the magnification formula as well as expression of decimal and standard form.  Synoptic links:   * biological membranes * cell division * organelles to greater detail elsewhere (e.g. respiration, photosynthesis, gene expression) * Pathogen types   [*MCQ -Cell (word)*](https://teachcambridge.org/item/42d268d2-1721-4896-896a-620b8160bc28)  [*MCQ - Cell (Part 1)*](https://teachcambridge.org/item/c2c8ad7a-03fa-405f-9df7-ad025c2de627) *(digital)*  [*MCQ – Cell (Part 2)*](https://teachcambridge.org/item/c2c8ad7a-03fa-405f-9df7-ad025c2de627) *(digital)* |
| 2.1.2 Biological Molecules | 25 hours | [2.1.2 Biological molecules](https://teachcambridge.org/item/99af3a76-39c2-4384-9590-d27bbb30d28c) | **Water:**  [Chemistry of water and its effects on pond ecology](https://www.britishecologicalsociety.org/wp-content/uploads/Education-Water-lesson.pdf) (ref:2.1.2a)  **Carbohydrates:**  [Introduction of starch as a polymer](http://www.rsc.org/learn-chemistry/resource/res00001741/making-a-plastic-from-potato-starch) – Making Plastic from potato starch (ref:2.1.2g)  **Proteins:**  [Activity to explore proteins by their different function](https://www.stem.org.uk/resources/elibrary/resource/34569/proteins) (ref:2.1.2m,n,o)  [PAG 10.1 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Molecular modelling (ref:2.1.2n)  **Qualitative Testing:**  [PAG9 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Carry out and interpret chemical tests (ref:2.1.2q)  [PAG5 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Colorimetry (ref: 2.1.2r)  [PAG6 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Chromatography (ref:2.1.2s)  An opportunity to use computer modelling to investigate the levels of protein structure within the molecule. | **Suggested resources:**  Use of molymods (if not available playdoh of different colour can be used) to represent the biological molecules. Useful when representing the different types of bonds.  To represent the levels of protein structure: glue a series of pieces of coloured paper together in a straight line in order to show primary, secondary and tertiary structure. Use white strips to represent the hydrogen bonds.  When teaching qualitative testing this can be used in context: e.g. Identify the diabetic using urine samples, sugar content in different types of juice etc.  **Additional guidance:**  Conjugated protein should include haemoglobin, insulin and a named enzyme  Fibrous proteins to include collagen, keratin and elastin  Maths opportunity for the calculation of *R*fvalue.  Synoptic links:   * enzymes * qualitative testing that allows us to track hydrolysis reactions * link to diagnosis using excretory products * Photosynthetic pigments   [*MCQ - Biochemistry*](https://teachcambridge.org/item/2ddebd1e-45bc-43b1-88e0-2140a99cd0de)*1(word)*  [*MCQ - Biochemistry2*](https://teachcambridge.org/item/c88ab547-962f-4117-978b-2bd0941f0b30)(word)  [MCQ – Biochemistry (Part 1) (digital)](https://teachcambridge.org/item/b1929157-60f9-41cf-9a59-89e32678bdcf)  [MCQ – Biochemistry (Part 2) (digital)](https://teachcambridge.org/item/aa0df7e4-2bee-4639-8cca-6c09001b552f) |
| 2.1.3 Nucleotides and nucleic acids | 8 hours | [2.1.3 Nucleotides and nucleic acids](https://teachcambridge.org/item/03fff902-dd8d-477a-a0c0-6f93d9c8edea) | An opportunity to use computer modelling to investigate nucleic acid structure.  [PAG 10.1 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Molecular modelling (ref:2.1.2n)  Alternative PAG10.1 can be found in [this blog.](https://www.ocr.org.uk/blog/alevel-biology-using-flexibility-ocr-pags/)  [Extraction of strawberry DNA](http://www.nuffieldfoundation.org/practical-biology/extracting-dna-living-things) | **Resources:**  No need to recall the chemical structure of nucleotide or nucleic acids.  Familiarise with DNA codons and RNA codons.  Comparison of function and structure of DNA, RNA and ATP.  DNA replication can be shown using pipe cleaners.  Transcription and translation can be represented with models, where students can visualise the process. [Teach Genetics](https://teach.genetics.utah.edu/content/dna/), University of Utah  [Translation animation](http://lab.concord.org/embeddable.html#interactives/sam/DNA-to-proteins/3-modeling-translation.json)  **Additional guidance:**  To include roles of the enzymes helicase, DNA polymerase. Importance of replication in conserving genetic information with accuracy and the occurrence of random, spontaneous mutations.  To include non-overlapping, degenerate and universal nature of the code  Role of RNA polymerase, mRNA, tRNA, rRNA  Synoptic links:   * DNA sequencing and genetic engineering * Enzymes * Function of eukaryotic organelles   [*MCQ - Nucleic acids*](https://teachcambridge.org/item/fe8e2ff7-9836-4c95-96e1-988a35e51ac8)  [*MCQ - Nuclei acids (digital)*](https://teachcambridge.org/item/3a3e031a-83d4-41f1-b3f5-7fff1aba5be4) |
| 2.1.4 Enzymes | 8 hours | [2.1.4 Enzymes](https://teachcambridge.org/item/42769e05-2394-4d57-9e44-6727ce47c600) | [PAG4](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [Catalase and hydrogen peroxide concentration reaction](http://www.nuffieldfoundation.org/practical-biology/investigating-enzyme-controlled-reaction-catalase-and-hydrogen-peroxide-concentrat) – Alternative  [Effect of temperature on the activity of lipase –](http://www.nuffieldfoundation.org/practical-biology/investigating-effect-temperature-activity-lipase) Alternative  [Effect of pH on amylase activity -](http://www.nuffieldfoundation.org/practical-biology/investigating-effect-ph-amylase-activity) Alternative  [Effect of concentration on the activity of trypsin](http://www.nuffieldfoundation.org/practical-biology/investigating-effect-concentration-activity-trypsin) – Alternative  [Effect of amylase on a starchy foodstuff](http://www.nuffieldfoundation.org/practical-biology/investigating-effect-amylase-starchy-foodstuff) – Synoptic practical on activity of enzymes and qualitative tests | **Resources:**  Teaching factors affecting the rate of reaction of the enzymes, students can be asked to design their own experiments in order to collect data, evaluate and make conclusions. Alternatively, PAGs/ practical activities can be attempted before teaching the content and allow students to research their results.  To include serial dilutions: introduce serial dilutions using [colour beads](https://www.jstor.org/stable/pdf/10.1525/abt.2010.72.5.9.pdf?refreqid=excelsior%3Aa17818bcf583135232c7bfec8fd9b11e)  Context approach- [Case study for inhibitory enzymes](http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=819&id=819)  **Additional guidance:**  To include catalase enzyme and amylase.  To include the chloride ion as a cofactor for amylase and vitamins as a source of coenzymes.  To include competitive and non-competitive, reversible and non-reversible inhibitors and the role of end-product inhibition.  Maths opportunity to calculate temperature coefficient (Q10), drawing and interpreting graphs, identify uncertainties, predict graph, represent linear relationship, calculate rates from graphs and measure the gradient on a curve.  Synoptic links:   * Hormones * Biological molecules – Qualitative tests   [*MCQ – Enzymes*](https://teachcambridge.org/item/a9d49565-a8b2-4d59-8467-40e809546486)  [*MCQ – Enzymes (digital)*](https://teachcambridge.org/item/7ca16777-d351-49b3-bf80-e1c3bb708b80) |
| 2.1.5 Biological membranes | 7 hours | [2.1.5 Biological membranes](https://teachcambridge.org/item/c6586877-f374-4cef-ba87-5818aa11f3b4) | [PAG8 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Transport in and out of cells  [PAG5 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Effect of temperature on membrane permeability  [Osmosis in bell pepper pericarp tissue](http://www.saps.org.uk/secondary/teaching-resources/1424-a-level-set-practicals-osmosis-in-bell-pepper-pericarp-tissue) – SAPS  [Effect of size on uptake by diffusion](http://www.nuffieldfoundation.org/practical-biology/effect-size-uptake-diffusion) – Nuffield foundation, opportunity to calculate SA:V ratio | **Resources:**  [Model representation of membrane](https://teach.genetics.utah.edu/content/cells/files/build-a-membrane.pdf) – University of Utah  [How can you test membrane permeability?](https://www.birmingham.ac.uk/study/undergraduate/schools-and-colleges/post-16/a-level-stem-resources/cell-membranes) – University of Birmingham, Videos and information about the research in membrane permeability.  Introduce diffusion by carrying out a simple demonstration using potassium permanganate diffusing in water.  Introduction of osmosis can be presented using visking tubing or by placing gummy bears into different concentrations of salt.  [Case study: from gummy bears to celery stalks](https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=1045&context=kb_pubs) – National Centre for case study teaching in science  **Additional guidance:**  To include the role of membranes  To include the effects of temperature and solvents  Maths opportunity to plot and interpret graphs, identify uncertainties, predict graph, represent linear relationship, calculate rates from graphs and measure the gradient on a curve. Calculations of surface area, volume and circumference  Synoptic links:   * Chemiosmosis in respiration and photosynthesis * Features of exchange surfaces   [*MCQ – Biological membranes*](https://teachcambridge.org/item/76ab2f1b-29bc-413b-b5b2-d3762cdf6f39)  [MCQ – Biological membranes (digital)](https://teachcambridge.org/item/445424d9-c035-404e-b18c-b1def468e514) |
| 2.1.6 Cell division, cell diversity and cellular organisation | 16 hours | [2.1.6 Cell division, cell diversity and cellular organisation](https://teachcambridge.org/item/92d8793a-3203-48e3-9014-c4b39fc220db) | [PAG1 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)- Microscopy  [Microscopy of root tip mitosis](http://www.saps.org.uk/secondary/teaching-resources/1358-a-level-set-practicals-microscopy-of-root-tip-mitosis) – SAPs with video demonstration and ppt  [Preparing an anther squash –](http://www.nuffieldfoundation.org/practical-biology/preparing-anther-squash) Alternative | **Resources:**  [KS4 to KS5 Cell division](https://teachcambridge.org/item/a50264fd-35cc-4172-a104-1c50a243c46f) (Transition guide)  Use of playdoh/pipe cleaners to help demonstrate the stages of mitosis and meiosis and visualise independent assortment and chiasmata  [How can we use microscopes to observe mitosis?-](https://www.birmingham.ac.uk/study/undergraduate/schools-and-colleges/post-16/a-level-stem-resources/mitosis-and-meiosis) University of Birmingham  Use photomicrographs from different species to identify the different stages of mitosis/meiosis.  [Cell division check point task](https://teachcambridge.org/item/65b14a85-b604-4f4b-9ce6-fa0f0d1633f8) – Student worksheet  [Cell division check point task](https://teachcambridge.org/item/339c963d-a5de-4913-b14f-7efcc1c3d95b) – Teacher worksheet  Context approach – [Saving Superman](https://static.nsta.org/case_study_docs/case_studies/superman.pdf)  Debate on the use of stem cells  **Additional guidance:**  Cell cycle – G1, S and G2, mitosis and cytokinesis  To include the changes in the organelles during mitosis and meiosis  Cells are specialised - erythrocytes, neutrophils, squamous and ciliated epithelial cells, sperm cells, palisade cells, root hair cells and guard cells. Including squamous and ciliated epithelia, cartilage, muscle, xylem and phloem as examples of tissues  Potential use of stem cells in research and medicine to include: repair of damaged tissues, the treatment of neurological conditions and research into developmental biology  [*MCQ – Cell division, cell diversity and cellular organisation*](https://teachcambridge.org/item/06587b45-6f72-466c-afcb-9042bc162ceb)  [*MCQ – Cell division, cell diversity and cellular organisation (digital)*](https://teachcambridge.org/item/fdbfaa00-140e-444f-8b22-551ad91a6c24) |

## Module 3: Exchange and transport

### Topic 3.1: Exchange and transport

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 3.1.1 Exchange surfaces | 9 hours | [3.1.1 Exchange surfaces](https://teachcambridge.org/item/ecfb1b0f-b109-428f-b5b7-d98edfaf2a82) | [PAG1.3](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Microscopy - Examine lung tissue  [Guidance on dissection](http://www.pskf.ca/sd/) of the gaseous exchange in bony fish (delivery guide) Alternative to PAG2  [Dissection of insect trachea](http://www.nuffieldfoundation.org/practical-biology/dissection-ventilation-system-locust) Alternative to PAG2  [Dissection of lungs](http://www.nuffieldfoundation.org/practical-biology/dissecting-lungs)  [Using spirometer](http://www.nuffieldfoundation.org/practical-biology/using-spirometer-investigate-human-lung-function) – PAG10 opportunity to use data logger to collect data | Resources:  [Video](https://www.samples-for-schools.co.uk/fish-head-dissection-lesson/) showing the dissection of gills - GCSE Samples for Schools (Subscribe)  [Oxygen supply](https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/8724-catalyst_15_1_212.pdf) – STEM article  [Studying lung surfactant](https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/8569-catalyst_18_2_337.pdf) – STEM article  Additional guidance:  To include analysis and interpretation of primary and secondary data e.g. from a data logger or spirometer. Compare and interpret graphs from data logger and kymographs.  Bony fish – changes in volume of the buccal cavity and the functions of the operculum, gill filaments and gill lamellae (gill plates); counter current flow  Insects – spiracles, trachea, thoracic and abdominal movement to change body volume, exchange with tracheal fluid  Maths opportunity to calculate surface area to volume ratio, use of significant figures and calculation of circumference surface area and volume.  Synoptic links:   * Cell membranes * Transport in animals   [*MCQ - Exchange Surfaces*](https://teachcambridge.org/item/cdf0f6c4-58a2-46bc-901b-0d2880098f4c)  [*MCQ - Exchange Surfaces (digital)*](https://teachcambridge.org/item/f6fa70d1-81ff-4d28-b69c-a6976c8354b8) |

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
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| 3.1.2 Transport in animals | 11 hours | [3.1.2 Transport in animals](https://teachcambridge.org/item/d55e6ab3-8d19-461d-b023-38aae6d89214) | [PAG2.1 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Dissection of the mammalian heart  [Dissection of the heart](http://www.nuffieldfoundation.org/practical-biology/looking-heart) – Alternative practical  [Observation of blood circulation in *Asellus*](http://www.nuffieldfoundation.org/practical-biology/observing-blood-circulation-asellus) – Demonstration | Resources:  [Video](https://www.samples-for-schools.co.uk/heart-dissection-lesson/) showing the dissection of the heart- GCSE Samples for school (subscribe)  Consider questions comparing the different circulatory systems and suggesting reason why each organism needs the specific circulatory system.  [Series of animations and illustrations](http://www.argosymedical.com/Circulatory/index.html) related with circulatory system  Cardiac output= heart rate x stroke volume  Use of ECG traces to interpret and describe, as well as graphs showing the pressure in the heart against time.  [Resource](https://www.medicalexamprep.co.uk/understanding-oxygen-dissociation-curve/) on oxygen dissociation curve  Opportunity to teach in context - synopticity: Case study: [A healthy retirement](https://static.nsta.org/case_study_docs/case_studies/heart_disease.pdf)?  (continued on next page) |
| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| 3.1.2 Transport in animals |  |  |  | Additional guidance:  To include hydrostatic pressure, oncotic pressure and an explanation of the differences in the composition of blood, tissue fluid and lymph  To include normal and abnormal heart activity e.g. tachycardia, bradycardia, fibrillation and ectopic heartbeat  Maths opportunity to plot and interpret graphs, identify uncertainties, predict graph, represent linear relationship, calculate rates from graphs and measure the gradient on a curve. Calculations of surface area, volume and circumference    Synoptic links:   * Biological molecules * Exchange surfaces * Patterns of inheritance * Respiration * Neuronal communication   [*MCQ- Transport in animals*](https://teachcambridge.org/item/6c2d7fe5-1ca3-449c-89e0-2e7440038bfd)  [MCQ – Transport in animals](https://teachcambridge.org/item/6c2d7fe5-1ca3-449c-89e0-2e7440038bfd) (digital) |
| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| 3.1.3 Transport in plants | 7 hours | [3.1.3 Transport in plants](https://teachcambridge.org/item/7fd04b98-c7ab-4774-a68a-25488afa52e8) | [PAG2.2 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Stem dissection  Additional [resources](http://www.saps.org.uk/secondary/teaching-resources/1325-a-level-set-practicals-dissection-and-microscopy-of-a-plant-stem) for stem dissection  [PAG 5.3 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)- Potometer  [Measuring stomatal density](http://www.nuffieldfoundation.org/practical-biology/window-past-measuring-stomatal-density) – Optional practical | Resources:  [Virtual Lab](https://sg.iwant2study.org/ospsg/index.php/interactive-resources/biology/1061-transpiration) for transpiration.    An opportunity to allow students to compare different types of experiment to investigate rate of transpiration. Identify improvements and evaluate.  Design their experiment to investigate the factors affecting transpiration.  Use of card models to represent cohesion and adhesion.  Additional guidance:  To include xylem vessels, sieve tube elements and companion cells.  Xerophytes (cacti and marram grass) and hydrophytes (water lilies)  Use of appropriate terminology is essential.  Maths opportunities to calculate volumes and rates, plotting of graphs and interpretation of data  Synoptic links:   * Exchange surfaces and adaptations * Respiration * Photosynthesis * Tissues and organs.   [MCQ – Transport in plants (digital)](https://teachcambridge.org/item/7aadb532-fb64-44f9-817e-4b35eb408649) |

## Module 4: Biodiversity, evolution and disease

### Topic 4.1: Communicable diseases, disease prevention and the immune system

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 4.1.1 Communicable diseases, disease prevention and the immune system | 16 hours | [4.1.1 Communicable diseases, disease prevention and the immune system](https://teachcambridge.org/item/b124af8a-c4f2-4fe7-95db-48475f9cacfe) | [PAG1.2 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Blood smears examination  A [series of practical](http://www.nuffieldfoundation.org/practical-biology/hygiene) activities to investigate how microbes develop | Resources:  [Autoimmune disease](https://www.immunology.org/public-information/bitesized-immunology/immune-dysfunction/autoimmunity-introduction)  Opportunity to practice the use of precise language. E.g. antibody vs antigen, T cells vs B cells, specific vs non-specific response, active vs passive immunity, immune vs resistant. Students are asked to explain the differences between those terms.  Immune system [poster](https://www.stem.org.uk/resources/elibrary/resource/460246/immune-response-poster?gad_source=1&gclid=EAIaIQobChMIkNmqxNrEhwMVdTCtBh32Sg44EAMYASAAEgKCF_D_BwE)  [Immune system scientific article](https://portlandpress.com/essaysbiochem/article/60/3/275/78223/The-immune-system) - Revision  Additional guidance:  No details of the symptoms of specific diseases is required  Non-specific defences to include skin, blood clotting (limited to platelets releasing substances that, via a cascade of events, result in the formation of fibrin which itself forms a network, trapping platelets and forming a clot), wound repair, inflammation, expulsive reflexes and mucous membranes.  Learners are **not** required to recall names of clotting factors or all steps of the clotting cascade.  Learners are not required to recall details of skin structure. Maths opportunities to plot, interpret and identify correlations in graphs. Also they should be able to understand the principles of sampling.  Synoptic links:   * Prokaryotic and eukaryotic cells. * Cell specialisation and level of organisation * Proteins and enzymes   [*MCQ-* Communicable diseases and the immune system. (digital)](https://teachcambridge.org/item/d2dfecbd-e5d6-40f6-8cb1-8e5410e4fb8d) |

### Topic 4.2: Biodiversity

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 4.2.1 Biodiversity | 11 hours | [4.2.1 Biodiversity](https://teachcambridge.org/item/32cc708c-c44e-4d7d-afea-9bd2c5935b10) | [PAG3 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Sampling | Resources:  Introduction to biodiversity article from ‘[The Guardian’](https://www.theguardian.com/news/2018/mar/12/what-is-biodiversity-and-why-does-it-matter-to-us)  [Guidance](https://www.rgs.org/media/epqgou23/gaguidetosimpsonsdiversityindex.pdf) on Simpson’s Index of Diversity – Royal society of geography  [Activity](https://www.nuffieldfoundation.org/sites/default/files/19_Ecology.pdf): Using cards to investigate Simpson’s Diversity Index  CPD from Field studies council need to sign up for free– [Biology Fieldwork](https://www.field-studies-council.org/digital-hub-plus/)  [Introduction to captive breeding](https://media.nationalgeographic.org/assets/activity/assets/captive-breeding-species-survival-1.pdf) – National Geographic  [World population growth curve 1750-2100](https://ourworldindata.org/world-population-growth)  Synoptic links:   * Investigating ecosystems * Genome   [MCQ -Biodiversity (digital)](https://teachcambridge.org/item/135c7f17-defc-4988-97f5-fd2c7e6ecd10) |
| 4.2.2 Classification and evolution | 11 hours | [4.2.2 Classification and evolution](https://teachcambridge.org/item/c344fcf9-dd42-4ceb-bd28-8711cbf829f6) |  | Resources:  Discussion topics – [Darwin today](https://www.ukri.org/publications/darwin-today-discussion-topics/)  [Factsheets](https://www.ukri.org/publications/darwin-today-factsheets/) – Darwin’s theory  [Wheat evolution](https://www.ukri.org/publications/wheat-breeding-and-evolution/) – ppt and activities  [Biomaths](https://www.ukri.org/publications/biomaths-maths-in-bioscience/) – ppts and resources  Additional guidance:  Learners are not required to know cladistics.  the contributions of Darwin and Wallace in formulating the theory of evolution by natural selection AND fossil, DNA (only genomic DNA at AS level) and molecular evidence  [*MCQ- Classification and evolution*](https://teachcambridge.org/item/a21c4e46-fa6f-4c19-a489-71da2351d5cc)  [*MCQ- Classification and evolution (digital)*](https://teachcambridge.org/item/8eecf5dd-f6e6-44f7-8d0a-8ef8a34488ba) |

## Module 5: Communication, homeostasis and energy

### Topic 5.1: Communication and homeostasis

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 5.1.1 Communication and homeostasis | 7 hours | [5.1.1 Communication and homeostasis](https://teachcambridge.org/item/9f019208-10a3-41a3-9ccd-1321a5286932) | Investigating animal responses  [PAG11 OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) | Resources:  An opportunity to monitor physiological functions in ectotherms and/or endotherms.  [Activity](http://www.nuffieldfoundation.org/practical-biology/interpreting-information-about-sweating-and-temperature)- Temperature control  Synoptic link:   * Membranes * Neuronal communication   [MCQ -Communication and homeostasis.](https://teachcambridge.org/item/008678d1-3156-471b-9103-5689cfbf4eba)(digital) |
| 5.1.2 Excretion as an example of homeostatic control | 9 hours | [5.1.2 Excretion as an example of homeostatic control](https://teachcambridge.org/item/46d4363d-6b33-4f56-8e99-7a20ecf8d191) | [PAG 1 Microscopy](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Opportunity to observe liver tissue under the microscope and practice drawing skills  [PAG 2 Dissection](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Opportunity to carry out dissection of the kidneys  [PAG 9.3 Qualitative testing glucose](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – Opportunity to use urine samples in diagnostic tests. | Resources:  Use of photomicrographs of liver tissue.  [Dissection of kidney video](https://www.samples-for-schools.co.uk/kidney-dissection-lesson/) – GCSE  Context approach - Liver failure – [Case studies](https://www.britishlivertrust.org.uk/stories/clares-story-2/), could be used as a starter activity  [Booklets](https://kidneyresearchuk.org/wp-content/uploads/2019/05/KR-decision-Aid-DOWNLOAD.pdf) containing further information on Dialysis, transplantation and Factsheets on kidney failure - KidneyCare UK  Additional Guidance:  the use of renal dialysis (haemodialysis only) and transplants for the treatment of kidney failure.  Synoptic links:   * Membranes * Homeostasis * Transport in animals * Neuronal communication * Qualitative tests   [MCQ- Homeostasis and excretion. (digital)](https://teachcambridge.org/item/fdd3a58d-dbec-4f0c-a1bf-0831bf779fbe) |
| 5.1.3 Neuronal Communication | 7 hours | [5.1.3 Neuronal communication](https://teachcambridge.org/item/877f7f0e-1e0b-4016-95ef-9d1e3902594e) | [Measuring reaction time of human nerve-controlled reaction](http://www.nuffieldfoundation.org/practical-biology/measuring-reaction-time-human-nerve-controlled-reaction) – Nuffield Foundation | Resources:  British Neuroscience Association resources mapped against the specifications – [Biology A](https://www.bna.org.uk/static/uploads/resources/A_Level_OCR_A.pdf)  Introduction to nervous system – [video](http://www.brainfacts.org/core-concepts/your-complex-brain)  Introduction to the neurones communication - [video](http://www.brainfacts.org/core-concepts/how-neurons-communicate)  Synoptic links:   * Membranes and their structure * Movement of substances * Animal responses   [MCQ - Neuronal communication. (digital)](https://teachcambridge.org/item/1f1659cb-2940-49d0-9ff7-dcf6cc33e01f) |

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 5.1.4 Hormonal Communication | 9 hours | [5.1.4 Hormonal Communication](https://teachcambridge.org/item/4a698c54-1ab4-4a2d-b17e-1335ac8a40c7) | PAG 9.3 Qualitative testing glucose – Opportunity to use urine samples in diagnostic tests.  PAG 1 Microscopy – Opportunity to observe pancreas tissue under the microscope and practice drawing skills. | Resources:  Introduction to endocrinology – [endocrine system](https://www.youtube.com/watch?v=kqtqfoS-Jtk)  Introduction of diabetes by analysing urine samples record data and suggesting reasons as to why glucose might be present in urine.  Use of pancreas’ photomicrographs from online. Interactive [microscope slides](http://histology.medicine.umich.edu/resources/pancreas#pancreas-slides): [pancreas](http://141.214.65.171/Histology/Digestive%20System/Liver%20and%20Pancreas/188_HISTO_20X.svs/view.apml), [interlobular ducts](http://141.214.65.171/Histology/Digestive%20System/Liver%20and%20Pancreas/188B_HISTO_40X.svs/view.apml?x=-0.1690399397&y=-0.2749723701&zoom=48.2253086420&transform=), [islets of Langerhans](http://141.214.65.171/Histology/Digestive%20System/Liver%20and%20Pancreas/190B_HISTO_40X.svs/view.apml?x=-0.1968898046&y=-0.1288542827&zoom=75.2375067645&transform=)  [Case studies](https://www.diabetes.org.uk/Your-stories) of people with diabetes.  [Video](https://www.youtube.com/watch?v=w7SjLNsvKg4)- This is diabetes  Additional guidance:  The use of insulin produced by genetically modified bacteria and the potential use of stem cells to treat diabetes mellitus  Maths opportunities to carry out calculations of magnification  Synoptic links:   * Protein structure * Cell membranes * Qualitative tests * Homeostasis * Movement of substances * Genetic Engineering (GCSE)   [*MCQ - Communication and homeostasis*](https://teachcambridge.org/item/0de430d7-0ae2-49ac-a6bc-f827f65dc2c4)  [*MCQ - Communication and homeostasis. (digital)*](https://teachcambridge.org/item/008678d1-3156-471b-9103-5689cfbf4eba) |
| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| 5.1.5 Plant and animal responses | 18 hours | [5.1.5 Plant and animal responses](https://teachcambridge.org/item/b81123f1-2b00-4f77-b19e-966d61c65d8c) | *Response in plants:*  Introduction to tropism in plants – [Demonstration: Tackling Tropisms](http://www.saps.org.uk/secondary/teaching-resources/1239-tackling-tropisms-gravitropism-and-phototropism) (SAPS)  [PAG 11.3 Plant phototropism](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – OCR suggested activities. Additional resources from [SAPS](http://www.saps.org.uk/secondary/teaching-resources/185-student-sheet-8-the-response-of-seedlings-to-light-phototropism-experiment)  [Interpreting an investigation of plant hormones –](http://www.nuffieldfoundation.org/practical-biology/interpreting-investigation-plant-hormones) Nuffield Foundation  [Gravitropism: the role of roots –](http://www.saps.org.uk/secondary/teaching-resources/1276-gravitropism-the-role-of-roots) SAPS | *Response in plants:*  Resources:  Leaf loss in deciduous plants - Intro [Video](https://www.youtube.com/watch?v=MX4K6kHb_6g)  Context – News article ([BBC](https://www.bbc.co.uk/news/business-47633086), [Independent](https://www.independent.co.uk/news/long_reads/monsanto-bayer-weedkiller-roundup-dewayne-johnson-court-glyphosate-world-health-organisation-a8586951.html#r3z-addoor)) about the use of weed killers (Synopticity plant hormones and cancer)  Context approach: [How plants grow in space?](http://www.saps.org.uk/secondary/teaching-resources/1238-tropisms-how-do-plants-grow-in-space) (resources by SAPS)  [Interpreting an investigation of plant hormones using auxin](http://www.saps.org.uk/secondary/teaching-resources/183-investigating-hormone-auxin-iaa-plant-growth-regulator) – SAPS (revision from GCSE)  An opportunity to monitor muscle contraction and fatigue using sensors to record electrical activity, when discussing sliding filament model and contraction of the muscle. This can be done using an electromyography and/or analysing results from an electromyography.  Additional guidance:  Practical Skills opportunity to develop serial dilutions and carry out calculations  Maths opportunity to calculate standard deviation and calculate Student’s t-test.  Synoptic links:   * Photosynthesis * Cell signalling * Cell membranes * Homeostasis |

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 5.1.5 Plant and animal responses |  |  | *Response in animals:*  [PAG11.1 – Exercise and Pulse Rate – OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [PAG 11.2 – Daphnia Heart rate – OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  PAG 1 – Microscopy: Observe muscles slides under the microscope  [PAG 2.3 – Dissection of the chicken wing – OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) | *Response in animals:*  Resources:  Context approach – Baby reflex movement (new-born baby is able to walk)  Why poison Frogs don’t poison themselves? - [National Geographic](https://www.nationalgeographic.com/animals/article/poison-frogs-toxins-venoms-resistance-animals)  [Brain structure](http://www.brainfacts.org/3d-brain#intro=false&focus=Brain-cerebral_hemisphere-frontal_lobe-middle_frontal_gyrus&zoom=false) – Interactive  MRI image (online) of healthy brain vs a brain tumour – Opportunities to identify the structures of the brain and the effects it will have on the body.  [Animation of reflex action](https://learninglink.oup.com/access/content/purves6xe-student-resources/animation-16-1?previousFilter=tag_animations)  Muscle Contraction - [Video](https://www.youtube.com/watch?v=LEP7sEiwsm0)  Revision GCSE – [How your heart works?](https://www.youtube.com/watch?time_continue=89&v=ep4cQrYFL0w)  Additional guidance:  Maths opportunity to calculate standard deviation and Student’s t-test  Synoptic links:   * Synapses * Protein structure * ATP * Cardiac Cycle |

### Topic 5.2: Energy for biological processes

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 5.2.1 Photosynthesis | 11 hours | [5.2.1 Photosynthesis](https://teachcambridge.org/item/35f3e01c-dace-4ed0-acba-9ce708fec17c) | [PAG6.3 TLC photosynthetic pigments](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – OCR suggested activity  [Investigating the light dependent reaction in photosynthesis](http://www.saps.org.uk/secondary/teaching-resources/1354-a-level-set-practicals-factors-affecting-rates-of-photosynthesis) – SAPS  PAG4 (Rates of reaction) [Investigating factors affecting the rate of photosynthesis](http://www.nuffieldfoundation.org/practical-biology/investigating-factors-affecting-rate-photosynthesis) – Nuffield Biology (Opportunity to develop IAPS)  [PAG12.3 Oxygen rate pondweed](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)- OCR suggested practical activity  Virtual Lab - [Photosynthesis](https://iwant2study.org/lookangejss/biology/ejss_model_photosynthesis/photosynthesis_Simulation.xhtml) (Opportunity to develop IAPS) | Resources:  [Understanding Photosynthesis](http://www.saps.org.uk/secondary/teaching-resources/283-photosynthesis-how-does-chlorophyll-absorb-light-energy) – Power point and word from SAPS  [Overview of photosynthesis](https://media.hhmi.org/biointeractive/click/photosynthesis/?_gl=1*1chtdgt*_ga*MjA2OTk3MDA3Mi4xNzIwNjg3Mzcz*_ga_H0E1KHGJBH*MTcyMTk5Nzk4Ny4yLjAuMTcyMTk5Nzk4Ny4wLjAuMA..)  Investigating photosynthesis and respiration [– Resources](http://www.saps.org.uk/secondary/teaching-resources/1224-algal-balls-photosynthesis-and-respiration-post-16) SAPS  An opportunity to use sensors, [data loggers](https://cd1.edb.hkedcity.net/cd/science/biology/resources/l&t2/practical/Practical-32.pdf) and software to process data.  Additional guidance:  Maths opportunity to calculate Rf values, rates and interpret and plot graphs.  Synoptic links:   * Qualitative tests – DCPIP * Enzymes * Cell ultrastructure - Eukaryotic cells * Respiration   [*MCQ - Photosynthesis*](https://teachcambridge.org/item/1d7c5637-7cfd-4c72-bc23-86534379c474)  [*MCQ - Photosynthesis (digital)*](https://teachcambridge.org/item/a5703c01-c838-456c-8322-a0c2cc2e556c) |

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 5.2.2 Respiration | 18 hours | [5.2.2 Respiration](https://teachcambridge.org/item/c5a32968-5abd-4792-b514-f5b56d9e0bf8) | Opportunities to design experiment practice IAPS: [Feeding a growing planet: respiration and ripening (protocols)](http://intobiology.org.uk/feeding-a-growing-planet-respiration-and-ripening-protocols/)  Introduction of the topic using demonstration: [Screaming Jelly Babies](https://www.stem.org.uk/elibrary/resource/31792)  [PAG12.1 Investigation into the respiration rate of *Saccharomyces cerevisiae*](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – OCR suggested activity  [PAG10.2 Turbidity (Rate of respiration)](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – OCR suggested practical  [Measuring respiratory quotient](http://www.nuffieldfoundation.org/practical-biology/measuring-respiratory-quotient) – Nuffield Foundation  [Measuring the rate of metabolism](http://www.nuffieldfoundation.org/practical-biology/measuring-rate-metabolism) – Nuffield Foundation  [PAG 4 Rates of enzymes reactions](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – OCR suggested practical | Resources:  Synopticity and context – [Feeding a growing planet: respiration and ripening](https://waysofthenaturalworld.wordpress.com/2021/04/05/feeding-a-growing-planet/)  Synopticity- [Animation: Respiration and photosynthesis (SAPS)](http://www.saps.org.uk/secondary/teaching-resources/113-secondary/collections/1281-animation-respiration-and-photosynthesis-gcse-a-level)  Context approach- [Naked mole rat treatment for stroke](https://www.thenakedscientists.com/articles/interviews/naked-mole-rat-treatment-stroke)  Electron transport system and ATP synthesis - [Animation](https://www.biointeractive.org/classroom-resources/atp-synthesis)  Cellular respiration glycolysis, Krebs cycle, electron transport - [3D animation](https://www.sumanasinc.com/webcontent/animations/content/cellularrespiration.html)  An opportunity to use sensors, data loggers and software to process data on anaerobic respiration.  Additional guidance:  Maths opportunity to calculate respiratory quotient (RQ), plot and interpret graphs  An opportunity to use standard deviation to measure the spread of a set of data and/or Student’s t-test to compare means of data values of two sets of data when carrying out investigation on effect of temperature, substrate conc. and different respiratory substrates on the rate of respiration.  Synoptic links:   * Cell ultrastructure – Eukaryotic cells * Membranes * Membrane signalling * Photosynthesis * Enzymes   [*MCQ - Respiration*](https://teachcambridge.org/item/f29a9821-c480-4a7e-838e-b6a49453b4cd)  [*MCQ - Respiration (digital)*](https://teachcambridge.org/item/c967d982-9832-4e51-9900-3ea21b31dd08) |

## Module 6: Genetics, evolution and ecosystems

### Topic 6.1: Genetics and evolution

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 6.1.1 Cellular control | 7 hours | [6.1.1 Cellular control](https://teachcambridge.org/item/747488c1-32e5-494b-bfb7-d9cd50c0f46a) | [PAG 10.1 DNA RasMol](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – OCR suggested activity  Alternative PAG10.1 can be found in [this blog.](https://www.ocr.org.uk/blog/alevel-biology-using-flexibility-ocr-pags/)  [MRC Cancer Model](https://social.ocr.org.uk/groups/science/conversations/network-modelling-cancer-pag10-exercise) – Science Community Forum (PAG 10 skills) | Resources:  [Article on mutations](https://www.nature.com/scitable/topicpage/genetic-mutation-1127) – Nature (independent reading)  [Homeobox genes](https://learn.genetics.utah.edu/content/basics/hoxgenes/) - support information  [KRAS: Cancer mutation](https://www.stem.org.uk/resources/elibrary/resource/29636/kras-cancer-mutation-activity) – Activity, ppt  Additional guidance:  Transcriptional level: lac operon, and transcription factors in eukaryotes.  Post-transcriptional level: the editing of primary mRNA and the removal of introns to produce mature mRNA.  Post-translational level: the activation of proteins by cyclic AMP  Synoptic links:   * Cell signalling * Manipulating genome |

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 6.1.3 Manipulating genome | 12 hours | [6.1.3 Manipulating genomes](https://teachcambridge.org/item/fe141e72-5f67-49df-a227-d497deaea34a) | [MRC Cancer Model](https://social.ocr.org.uk/groups/science/conversations/network-modelling-cancer-pag10-exercise) – Science Community Forum (PAG 10 skills)  [PAG 10.1 DNA RasMol](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – OCR suggested activity | Resources:  [Sanger sequencing](https://www.dnalc.org/resources/3d/29-sanger-sequencing.html) – 3D animation (simple explanation)  [PCR](https://www.dnalc.org/resources/3d/19-polymerase-chain-reaction.html) – 3D animation  [DNA sequencing technologies](https://www.nature.com/scitable/topicpage/dna-sequencing-technologies-690) – Nature Article  Context approach - Introducing gel electrophoresis by reference to ‘DNA paternity test kits’.  [Gel electrophoresis](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/) – Video and instructions of how to carry it out  Context approach – News articles on genetic engineering (e.g. [The chickens that lay anti- cancer drugs - Article](https://www.bbc.co.uk/news/science-environment-46993649?intlink_from_url=https://www.bbc.co.uk/news/topics/cywd23g04nlt/genetic-engineering&link_location=live-reporting-story), [Salmon fed genetically modified plants in nutrition trail - Video](https://www.bbc.co.uk/news/av/science-environment-45023103/salmon-fed-genetically-modified-plants-in-nutrition-trial?intlink_from_url=https%3A%2F%2Fwww.bbc.co.uk%2Fnews%2Ftopics%2Fcywd23g04nlt%2Fgenetic-engineering&link_location=live-reporting-map)), Opportunity to carry out a debate for against genetic engineering and the implications it will have in society.  [Pharming](https://learn.genetics.utah.edu/content/science/pharming/) – Background information  [Soy natural: genetic resistance against aphids](https://www.sciencedaily.com/releases/2018/08/180829081320.htm) (Opportunity to develop IAPS)  Additional guidance:  DNA sequencing, need to know the scientific knowledge and have an understanding of how it develops over time.  Synoptic links:   * Biological molecules * Nucleotides and nucleic acids   [*MCQ - Genetics and evolution*](https://teachcambridge.org/item/b66d9a15-1724-4593-86a9-9b8ccec48767)  [*MCQ - Genetics and evolution (digital)*](https://teachcambridge.org/item/b66d9a15-1724-4593-86a9-9b8ccec48767) |
| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| 6.1.2 Patterns of inheritance | 12 hours | [6.1.2 Patterns of inheritance](https://teachcambridge.org/item/0aeb8c91-9308-4074-b225-55a8bf2bc787) | [PAG 12.2 Fruit fly crosses and analysis](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all) – OCR suggested practical activity  [Introducing ideas about inheritance (Opportunity to develop language of measurement)](http://www.nuffieldfoundation.org/practical-biology/introducing-ideas-about-inheritance) – Nuffield Foundation  [A model of natural selection – spaghetti worms](http://www.nuffieldfoundation.org/practical-biology/model-natural-selection-%E2%80%93-spaghetti-worms) – Nuffield Foundation | Resources:  [DNA in the garden](https://www.ukri.org/wp-content/uploads/2014/02/BBSRC-130214-DNA-in-the-garden-poster.pdf) – Activity (opportunity to develop IAPS)  [Pigeon Breeding: Genetics at work (activity)](https://teach.genetics.utah.edu/content/pigeons/) – University of Utah  [Genetic drift and effective population size](https://www.nature.com/scitable/topicpage/genetic-drift-and-effective-population-size-772523) – Article on Nature (opportunity to develop IAPS)  Use sweets to represent the genetic drift – Skittle Island [(Population genetics)](https://digitalcommons.imsa.edu/cgi/viewcontent.cgi?article=1004&context=abs_unit_1)  [Speciation resources & case studies](https://teach.genetics.utah.edu/content/evolution/speciation/) – University of Utah  Additional guidance:  To include explanations of linkage and epistasis. Students are expected to know the principle of epistasis and apply their knowledge in different contexts. Should be able to identify the difference between recessive, dominant and complementary epistasis, by applying their knowledge.  Maths opportunity by using the Hardy-Weinberg equation  Synoptic links:   * Ecosystems * Classification and evolution * Biodiversity |

### Topic 6.2: Cloning and biotechnology

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 6.2.1 Cloning and biotechnology | 15 hours | [6.2.1 Cloning and biotechnology](https://teachcambridge.org/item/947ed08f-7f45-4835-8c94-d0418b08c0f3) | [PAG7 Microbiology](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [Cauliflower cloning – Tissue Culture and micropropagation](http://www.saps.org.uk/secondary/teaching-resources/706-cauliflower-cloning-tissue-culture-and-micropropagation) – SAPS  PAG 4 – Enzymes rate of reactions | Resources:  Debates on the ethical issues for and against cloning and biotechnology  Articles on cloning – [Scientists have cloned monkeys and it could help treat cancer](https://www.newscientist.com/article/mg23731623-600-scientists-have-cloned-monkeys-and-it-could-help-treat-cancer/)  [Antimicrobial agent](https://www.youtube.com/watch?v=hejV-wmuZio) – University of Birmingham (Video)  Additional guidance:  Maths opportunities for growth curves including log growth, calculating rates of reactions, plotting and interpreting graphs.  Synoptic links:   * Enzymes * Mutations * Serial dilutions   [*MCQ - Cloning and biotechnology*](https://teachcambridge.org/item/60032b23-976d-4123-bce3-d159572b6ed1)  [*MCQ - cloning and biotechnology (digital)*](https://teachcambridge.org/item/f179df9e-d399-45e7-81b5-bfd09af57717) |

### Topic 6.3: Ecosystems

| Specification reference | Suggested teaching time | Delivery guide | Practical work | Notes |
| --- | --- | --- | --- | --- |
| 6.3.1 Ecosystems | 8 hours | [6.3.1 Ecosystems](https://teachcambridge.org/item/ac1808e2-3a1d-4b8f-9454-76460a7b0c9b) | [PAG3](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [OCR suggested activities](https://teachcambridge.org/a93efea2-be7b-4ebb-8f43-8674b1a02443/practical-activity-groups-pags?subject=6c7501ed-dcb7-4359-8d5f-71d220ae45d0&unit=all)  [Biodiversity in your backyard!](http://www.nuffieldfoundation.org/practical-biology/biodiversity-your-backyard) – Nuffield foundation  [Microbes ate my homework](http://www.nuffieldfoundation.org/practical-biology/microbes-ate-my-homework) – Nuffield Foundation  [Nitrogen-fixing bacteria in root nodules of leguminous plants](http://www.nuffieldfoundation.org/practical-biology/nitrogen-fixing-bacteria-root-nodules-leguminous-plants) – Nuffield Foundation | Resources:  [Species diversity](https://www.birmingham.ac.uk/study/undergraduate/schools-and-colleges/post-16/a-level-stem-resources/species-diversity) – Video (University of Birmingham)  [Coral reef succession](https://media.nationalgeographic.org/assets/activity/assets/coral-reef-succession-1.pdf) – National Geographic activity  [Energy transfer in ecosystems](https://www.stem.org.uk/resources/community/collection/21628/energy-transfer-ecosystems) – STEM learning  [Energy transfer (Catalyst article)](https://www.stem.org.uk/resources/elibrary/resource/27710/energy-transfer) – STEM learning  Additional guidance:  Maths opportunity to carry out calculations, evaluate and interpret results. Statistical analysis.  Include the following microorganisms: Nitrosomonas, Nitrobacter, Azotobacter and Rhizobium.  Reference to deflected succession.  Synoptic links:   * Measuring biodiversity * Photosynthesis * Evolution   [MCQ – Ecosystems (digital)](https://teachcambridge.org/item/e06575d8-1c7b-4204-ba81-bc343a15f7b5) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 6.3.2 Populations and sustainability | 8 hours | [6.3.2 Populations and sustainability](https://teachcambridge.org/item/59d0a89a-1eae-4900-8afe-3146e171e619) |  | Resources:  [An introduction to population growth](https://www.nature.com/scitable/knowledge/library/an-introduction-to-population-growth-84225544/) – Nature article (Opportunity to develop IAPS)  [Dynamics of predation](https://www.nature.com/scitable/knowledge/library/dynamics-of-predation-13229468) – Nature article  Prey-predator relationship: provide students with date to plot and interpret graphs.  Conservation vs preservation discussion to share their thoughts. Construct a table to discuss the benefits for each and where it could be applied best.  Examples of ecosystems that can be managed to balance the conflict between conservation/ preservation and human needs:   * the Masai Mara region in Kenya Masai Mara region – [The challenges of a world unique ecosystem](http://maasaimarascience.org/fileadmin/projects/masaimara/MMSDI_Policy_Paper_Final.pdf) (Data analysis, opportunities for a debate, synopticity with biodiversity, communicable diseases) * Terai region of Nepal, ([Strategy and action plan 2015-2025](https://conservationcorridor.org/cpb/Ministry-of-Forests-and-Soil-Conservation-Nepal_2015.pdf)) * Peat bogs [Resources pack activity](https://naturalresources.wales/guidance-and-advice/business-sectors/education-and-skills/looking-for-learning-resources/learning-resources-search-by-topic/peatland-bogs/?lang=en)   Examples of effects of human activities on the animal and plant populations and how these are controlled in environmentally sensitive ecosystems: the Galapagos Islands, Antarctica, Snowdonia National Park, the Lake District  An opportunity for students to read through the information and present to their peers  Additional guidance:  Include the economic, social and ethical reasons for conservation of biological resources  Include timber production and fishing in the management of an ecosystem.  Synoptic links:   * Biodiversity * Classification and evolution   [*MCQ – Ecosystems*](https://teachcambridge.org/item/3be86aeb-874f-4379-9e39-d99ce3c105f2)  [*MCQ – Ecosystems (digital)*](https://teachcambridge.org/item/e06575d8-1c7b-4204-ba81-bc343a15f7b5) |

Document updates:

V1.0 2017 Original version

V1.1 February 2019 Addition of section 3.1.3f. Additional notes for: 3.1.2 f, 4.2.1 b, 6.2.1 h

V2.0 June 2019 Addition of Suggested practical work and resources/links in the ‘Notes’ column. Removed learning outcome

column.

V2.1 April 2022 Removal of PAG 9 as a suggested practical work, for spec reference ‘2.1.3 Nucleotides and nucleic acids’

V2.2 July 2024 Updated SoW in order to be in line with the updated A level Biology Spec A update [(version 3.2)](https://www.ocr.org.uk/Images/687834-download-a-level-specification.pdf) and updated dead links.

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation’s website for a direct search.



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