PERSONALISED LEARNING CHECKLISTS

GCSE Science BIOLOGY Separates: PERSONALISED LEARNING CHECKLIST				
	Red	**Amber**	**Green**	**Revised** Tick ☑
Area of Study: Cell Biology				
Plant/animal cells and their organelles/structure				
Bacterial cells and their organelles/structure				
Differences between prokaryotes and eukaryotes				
Cells may be specialised to carry out a particular function: • sperm cells, nerve cells and muscle cells in animals • root hair cells, xylem and phloem cells in plants.				
Cell differentiation in plant and animal cells				
Understand how microscopy techniques have developed over time				
Explain how electron microscopy has increased understanding of sub-cellular structures.				
Carry out calculations involving magnification, real size and image size using the formula: magnification = size of image / size of real object				
Required practical activity 1: using a light microscope				
Describe how bacteria multiply by simple cell division (binary fission)				
Required practical activity 2: investigate the effect of antiseptics or antibiotics on bacterial growth				
The contents of the nucleus including chromosomes and genes				
How cells divide by the process of mitosis				
Describe the stages of the cell cycle				
Describe the function of stem cells in embryos, in adult animals and in the meristems in plants				
Evaluate the uses and implications of stem cell treatment				
Explain the process of therapeutic cloning				
Define diffusion				
Describe which factors affect the rate of diffusion				

Calculate and compare surface area to volume ratios.				
Explain how different multicellular organisms have adapted exchange surfaces				
Define osmosis				
Required practical activity 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue				
Define active transport and describe it happening with mineral uptake in root hair cells and uptake of sugar molecules in the gut of humans				
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Area of Study: Organisation				
Define the term tissue and give examples.				
Define and give examples of organs.				
Define and give examples of organ system.				
Label and describe the functions of the digestive system.				
Describe how enzymes catalyse specific and be able to use the 'lock and key theory' as a simplified model to explain it.				
How enzymes are affected by temp and pH changes.				
Be able to carry out rate calculations.				
Be able to recall the sites of production and the action of amylase, proteases and lipases.				
How the adaptations of the small intestine allow digested food molecules to be absorbed into the bloodstream.				
Describe how the products of digestion are used.				
Describe and explain the action of bile in digestion.				
Know the structure and functioning of the human heart and its associated blood vessels.				
Know the structure of the lungs, including how lungs are adapted for gaseous exchange.				
Explain how the pacemaker controls its heart rate and how Artificial pacemakers are used to correct irregularities.				
Explain how the structure of arteries, veins and capillaries relates to their functions.				

Know the functions of each of the blood components, plasma, red blood cells, white blood cells and platelets.				
Recognise different types of blood cells in a photograph or diagram, and how they are adapted to their functions.				
Evaluate the advantages and disadvantages of treating cardiovascular diseases by drugs (statins), mechanical devices (valves, stents, artificial heart) or transplant.				
Describe the consequences of faulty valves and replacement biological or mechanical valves.				
Define the term 'Health'.				
Define and give examples of 'communicable diseases' and 'non-communicable', as major causes of ill health.				
Describe how diet, stress and life situations may have an effect on both physical and mental health.				
Explain how different types of disease may interact.				
Be able to translate disease incidence information between graphical and numerical forms, construct and interpret frequency tables and diagrams, bar charts and histograms.				
Understand the principles of sampling as applied to scientific data, including epidemiological data.				
Discuss the human and financial cost of non communicable diseases to an individual, a local community, a nation or globally.				
Explain the effect of lifestyle factors including diet, alcohol and smoking on the incidence of non-communicable diseases at local, national and global levels.				
Be able to use a scatter diagram to identify a correlation between two variables in terms of risk factors.				
describe how cancer results as a change in cell growth and division.				
Describe the differences between benign and malignant tumours,				
Explain how lifestyle and genetic risk factors can increase the likelihood for various types of cancer.				
Required practical activity 4: use qualitative reagents to test for a range of carbohydrates, lipids and proteins				

Required practical activity 5: investigate the effect of pH on the rate of reaction of amylase enzyme.				
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Area of Study: Infection and Response				
How diseases are spread and how this spread can be reduced				
How we can culture bacteria				
The definition of 'pathogen' and how they make us ill				
Examples of viral, bacterial and fungal diseases – how they spread and how they are treated				
Malaria as an example of a protist disease, including the malarial protist life cycle, symptoms and treatment				
1st line (non-specific) defence systems of the human body and how they work				
The role of white blood cells in the immune system				
Vaccinations and how they prevent disease				
The use of antibiotics and how antibiotic resistance arises. The discovery of penicillin by Fleming				
The use of painkillers and the origins of aspirin				
Traditionally drugs were extracted from plants and micro-organisms eg. Digitalis, aspirin and penicillin				
The stages of drug testing and what is being tested at each point				
The meaning of the key terms 'placebo' and 'double blind trial'				
Monoclonal antibodies and how they are produced				
Uses of monoclonal antibodies				
Advantages and disadvantages of monoclonal antibodies				
The general symptoms of plant disease and how they can be diagnosed				
Examples of plant disease, and their symptoms/effects on plants (Tobacco mosaic virus, Rose black spot and aphids)				
The damage caused to plants by ion deficiencies				

Plant defence responses (physical responses, chemical responses and mechanical adaptations)				
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Area of Study: Bioenergetics				
Photosynthesis is represented by the equation: $\text{carbon dioxide} + \text{water} \xrightarrow{\text{light}} \text{glucose} + \text{oxygen}$				
I recognise, and can name these symbols: CO_2, H_2O, O_2 and $C_6H_{12}O_6$.				
I can describe photosynthesis as an endothermic reaction in which energy is transferred from the environment to the chloroplasts by light.				
I can explain the effects of temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll on the rate of photosynthesis.				
I can: • measure and calculate rates of photosynthesis • extract and interpret graphs of photosynthesis rate involving one limiting factor • plot and draw appropriate graphs selecting appropriate scale for axes • translate information between graphical and numeric form.				
Higher Tier only: These factors interact and any one of them may be the factor that limits photosynthesis.				
Higher Tier only: I can explain graphs of photosynthesis rate involving two or three factors and decide which is the limiting factor.				
Higher Tier only: I understand and can use inverse proportion – the inverse square law and light intensity in the context of photosynthesis.				
Higher Tier only:				

Limiting factors are important in the economics of enhancing the conditions in greenhouses to gain the maximum rate of photosynthesis while still maintaining profit.				
Required Practical 6: I have investigated the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed.				
The glucose produced in photosynthesis may be: • used for respiration • converted into insoluble starch for storage • used to produce fat or oil for storage • used to produce cellulose, which strengthens the cell wall • used to produce amino acids for protein synthesis.				
To produce proteins, plants also use nitrate ions that are absorbed from the soil.				
I can describe cellular respiration as an exothermic reaction which is continuously occurring in living cells.				
The energy transferred from respiration supplies all the energy needed for living processes.				
Respiration in cells can take place aerobically (using oxygen) or anaerobically (without oxygen), to transfer energy.				
I can compare the processes of aerobic and anaerobic respiration with regard to the need for oxygen, the differing products and the relative amounts of energy transferred.				
Organisms need energy for: • chemical reactions to build larger molecules • movement • keeping warm.				
Aerobic respiration is represented by the equation: glucose + oxygen → carbon dioxide + water				
I can recognise and name these symbols:				

$C_6H_{12}O_6$, O_2, CO_2 and H_2O.				
Anaerobic respiration in muscles is represented by the equation: glucose → lactic acid				
As the oxidation of glucose is incomplete in anaerobic respiration much less energy is transferred than in aerobic respiration.				
Anaerobic respiration in plant and yeast cells is represented by the equation: glucose → ethanol + carbon dioxide				
Anaerobic respiration in yeast cells is called fermentation and has economic importance in the manufacture of bread and alcoholic drinks.				
During exercise the human body reacts to the increased demand for energy. The heart rate, breathing rate and breath volume increase during exercise to supply the muscles with more oxygenated blood.				
If insufficient oxygen is supplied anaerobic respiration takes place in muscles. The incomplete oxidation of glucose causes a build up of lactic acid and creates an oxygen debt. During long periods of vigorous activity muscles become fatigued and stop contracting efficiently.				
Higher Tier only: Blood flowing through the muscles transports the lactic acid to the liver where it is converted back into glucose. Oxygen debt is the amount of extra oxygen the body needs after exercise to react with the accumulated lactic acid and remove it from the cells.				
Students should be able to explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, proteins and lipids.				
Metabolism is the sum of all the reactions in a cell or the body.				
The energy transferred by respiration in cells is used by the organism for the continual enzyme controlled processes of metabolism that synthesise new molecules.				

Metabolism includes: • conversion of glucose to starch, glycogen and cellulose • the formation of lipid molecules from a molecule of glycerol and three molecules of fatty acids • the use of glucose and nitrate ions to form amino acids which in turn are used to synthesise proteins • respiration • breakdown of excess proteins to form urea for excretion.				
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Area of Study: Homeostasis and response				
I am able to explain that homeostasis is the regulation of the internal conditions of a cell or organism to maintain optimum conditions for function in response to internal and external changes.				
Homeostasis maintains optimal conditions for enzyme action and all cell functions.				
In the human body, these include control of: • blood glucose concentration • body temperature • water levels.				
These automatic control systems may involve nervous responses or chemical responses.				
All control systems include: • cells called receptors, which detect stimuli (changes in the environment) • coordination centres (such as the brain, spinal cord and pancreas) that receive and process information from receptors • effectors, muscles or glands, which bring about responses which restore optimum levels.				
I can explain how the structure of the nervous system is adapted to its functions.				

The nervous system enables humans to react to their surroundings and to coordinate their behaviour.				
Information from receptors passes along cells (neurones) as electrical impulses to the central nervous system (CNS). The CNS is the brain and spinal cord. The CNS coordinates the response of effectors which may be muscles contracting or glands secreting hormones.				
stimulus → receptor → coordinator → effector → response				
I can explain how the various structures in a reflex arc – including the sensory neurone, synapse, relay neurone and motor neurone – relate to their function. I understand why reflex actions are important.				
Reflex actions are automatic and rapid; they do not involve the conscious part of the brain.				
I can extract and interpret data from graphs, charts and tables, about the functioning of the nervous system.				
I can translate information about reaction times between numerical and graphical forms.				
I have completed required practical 7: To plan and carry out an investigation into the effect of a factor on human reaction time.				
The brain controls complex behaviour. It is made of billions of interconnected neurones and has different regions that carry out different functions.				
I can identify the cerebral cortex, cerebellum and medulla on a diagram of the brain, and describe their functions.				
Higher Tier only: Students should be able to explain some of the difficulties of investigating brain function and treating brain damage and disease.				
Higher Tier only: Neuroscientists have been able to map the regions of the brain to particular functions by studying patients with brain damage, electrically stimulating different parts of the brain and using MRI				

scanning techniques. The complexity and delicacy of the brain makes investigating and treating brain disorders very difficult.				
I can relate the structures of the eye to their functions. This includes: • accommodation to focus on near or distant objects • adaptation to dim light.				
The eye is a sense organ containing receptors sensitive to light intensity and colour.				
I am able to identify the following structures on a diagram of the eye and explain how their structure is related to their function: • retina • optic nerve • sclera • cornea • iris • ciliary muscles • suspensory ligaments.				
Accommodation is the process of changing the shape of the lens to focus on near or distant objects.				
To focus on a near object: • the ciliary muscles contract • the suspensory ligaments loosen • the lens is then thicker and refracts light rays strongly.				
To focus on a distant object: • the ciliary muscles relax • the suspensory ligaments are pulled tight • the lens is then pulled thin and only slightly refracts light rays.				
Two common defects of the eyes are myopia (short sightedness) and hyperopia (long sightedness) in which rays of light do not focus on the retina. • Generally these defects are treated with spectacle lenses which refract the light rays so that they do focus on the retina.				

• New technologies now include hard and soft contact lenses, laser surgery to change the shape of the cornea and a replacement lens in the eye.				
I can interpret ray diagrams, showing these two common defects of the eye and demonstrate how spectacle lenses correct them.				
Body temperature is monitored and controlled by the thermoregulatory centre in the brain. The thermoregulatory centre contains receptors sensitive to the temperature of the blood. The skin contains temperature receptors and sends nervous impulses to the thermoregulatory centre.				
If the body temperature is too high, blood vessels dilate (vasodilation) and sweat is produced from the sweat glands. Both these mechanisms cause a transfer of energy from the skin to the environment.				
If the body temperature is too low, blood vessels constrict (vasoconstriction), sweating stops and skeletal muscles contract (shiver).				
Higher Tier only: I am able to explain how these mechanisms lower or raise body temperature in a given context.				
I am able to describe the principles of hormonal coordination and control by the human endocrine system.				
The endocrine system is composed of glands which secrete chemicals called hormones directly into the bloodstream. The blood carries the hormone to a target organ where it produces an effect. Compared to the nervous system the effects are slower but act for longer.				
The pituitary gland in the brain is a 'master gland' which secretes several hormones into the blood in response to body conditions. These hormones in turn act on other glands to stimulate other hormones to be released to bring about effects.				
Students should be able to identify the position of the following on a diagram of the human body: • pituitary gland • pancreas • thyroid • adrenal gland				

• ovary • testes.				
Blood glucose concentration is monitored and controlled by the pancreas.				
If the blood glucose concentration is too high, the pancreas produces the hormone insulin that causes glucose to move from the blood into the cells. In liver and muscle cells excess glucose is converted to glycogen for storage.				
I am able to explain how insulin controls blood glucose (sugar) levels in the body.				
Type 1 diabetes is a disorder in which the pancreas fails to produce sufficient insulin. It is characterised by uncontrolled high blood glucose levels and is normally treated with insulin injections.				
In Type 2 diabetes the body cells no longer respond to insulin produced by the pancreas. A carbohydrate controlled diet and an exercise regime are common treatments. Obesity is a risk factor for Type 2 diabetes.				
I am able to compare Type 1 and Type 2 diabetes and explain how they can be treated.				
I am able to extract information and interpret data from graphs that show the effect of insulin in blood glucose levels in both people with diabetes and people without diabetes.				
Higher Tier only: If the blood glucose concentration is too low, the pancreas produces the hormone glucagon that causes glycogen to be converted into glucose and released into the blood.				
Higher Tier only: I am able to explain how glucagon interacts with insulin in a negative feedback cycle to control blood glucose (sugar) levels in the body.				
I am able to explain the effect on cells of osmotic changes in body fluids.				
Water leaves the body via the lungs during exhalation. Water, ions and urea are lost from the skin in sweat.				

There is no control over water, ion or urea loss by the lungs or skin.				
Excess water, ions and urea are removed via the kidneys in the urine.				
If body cells lose or gain too much water by osmosis they do not function efficiently.				
Higher Tier only: The digestion of proteins from the diet results in excess amino acids which need to be excreted safely. In the liver these amino acids are deaminated to form ammonia. Ammonia is toxic and so it is immediately converted to urea for safe excretion.				
Students should be able to describe the function of kidneys in maintaining the water balance of the body.				
The kidneys produce urine by filtration of the blood and selective reabsorption of useful substances such as glucose, some ions and water.				
(Knowledge of other parts of the urinary system, the structure of the kidney and the structure of a nephron is not required).				
I am able to translate tables and bar charts of glucose, ions and urea before and after filtration.				
Higher Tier only: Students should be able to describe the effect of ADH on the permeability of the kidney tubules.				
Higher Tier only: The water level in the body is controlled by the hormone ADH which acts on the kidney tubules. ADH is released by the pituitary gland when the blood is too concentrated and it causes more water to be reabsorbed back into the blood from the kidney tubules. This is controlled by negative feedback.				
People who suffer from kidney failure may be treated by organ transplant or by using kidney dialysis. I understand the basic principles of dialysis.				
Students should be able to describe the roles of hormones in human reproduction, including the menstrual cycle.				
During puberty reproductive hormones cause secondary sex characteristics to develop.				

Oestrogen is the main female reproductive hormone produced in the ovary. At puberty eggs begin to mature and one is released approximately every 28 days. This is called ovulation.				
Testosterone is the main male reproductive hormone produced by the testes and it stimulates sperm production.				
Several hormones are involved in the menstrual cycle of a woman. • Follicle stimulating hormone (FSH) causes maturation of an egg in the ovary. • Luteinising hormone (LH) stimulates the release of the egg. • Oestrogen and progesterone are involved in maintaining the uterus lining.				
Higher Tier only: I am able to explain the interactions of FSH, oestrogen, LH and progesterone, in the control of the menstrual cycle.				
Higher Tier only: Students should be able to extract and interpret data from graphs showing hormone levels during the menstrual cycle.				
I can evaluate the different hormonal and non-hormonal methods of contraception.				
Fertility can be controlled by a variety of hormonal and non-hormonal methods of contraception. These include: • oral contraceptives that contain hormones to inhibit FSH production so that no eggs mature • injection, implant or skin patch of slow release progesterone to inhibit the maturation and release of eggs for a number of months or years • barrier methods such as condoms and diaphragms which prevent the sperm reaching an egg • intrauterine devices which prevent the implantation of an embryo or release a hormone				

• spermicidal agents which kill or disable sperm • abstaining from intercourse when an egg may be in the oviduct • surgical methods of male and female sterilisation.				
Students should be able to explain the use of hormones in modern reproductive technologies to treat infertility. This includes giving FSH and LH in a 'fertility drug' to a woman. She may then become pregnant in the normal way.				
In Vitro Fertilisation (IVF) treatment. • IVF involves giving a mother FSH and LH to stimulate the maturation of several eggs. • The eggs are collected from the mother and fertilised by sperm from the father in the laboratory. • The fertilised eggs develop into embryos. • At the stage when they are tiny balls of cells, one or two embryos are inserted into the mother's uterus (womb).				
Although fertility treatment gives a woman the chance to have a baby of her own: • it is very emotionally and physically stressful • the success rates are not high • it can lead to multiple births which are a risk to both the babies and the mother.				
Higher Tier only: Students should be able to explain the roles of thyroxine and adrenaline in the body.				
Higher Tier only: Adrenaline is produced by the adrenal glands in times of fear or stress. It increases the heart rate and boosts the delivery of oxygen and glucose to the brain and muscles, preparing the body for 'flight or fight'.				
Higher Tier only: Thyroxine from the thyroid gland stimulates the basal metabolic rate. It plays an important role in growth and development.				
Higher Tier only:				

Thyroxine levels are controlled by negative feedback.				
Plants produce hormones to coordinate and control growth and responses to light (phototropism) and gravity (gravitropism or geotropism). Unequal distributions of auxin cause unequal growth rates in plant roots and shoots.				
Higher Tier only: Gibberellins are important in initiating seed germination.				
Higher Tier only: Ethene controls cell division and ripening of fruits.				
Higher Tier only: (The mechanisms of how gibberellins and ethene work are not required).				
Required Practical 8: I have investigated the effect of light or gravity on the growth of newly germinated seedlings and have recorded results as both length measurements and as careful, labelled biological drawings to show the effects.				
Higher Tier only: I am able to describe the effects of some plant hormones and the different ways people use them to control plant growth.				
Higher Tier only: Plant growth hormones are used in agriculture and horticulture.				
Higher Tier only: Auxins are used: • as weed killers • as rooting powders • for promoting growth in tissue culture.				
Higher Tier only: Ethene is used in the food industry to control ripening of fruit during storage and transport.				
Higher Tier only: Gibberellins can be used to:				

• end seed dormancy • promote flowering • increase fruit size.				
	Red	**Amber**	**Green**	**Revised** Tick ☑
Area of Study: Inheritance, Variation and Evolution				
I understand that meiosis leads to non-identical cells being formed while mitosis leads to identical cells being formed.				
Sexual reproduction involves the joining (fusion) of male and female gametes: • sperm and egg cells in animals • pollen and egg cells in flowering plants.				
In sexual reproduction there is mixing of genetic information which leads to variety in the offspring. The formation of gametes involves meiosis.				
Asexual reproduction involves only one parent and no fusion of gametes. There is no mixing of genetic information. This leads to genetically identical offspring (clones). Only mitosis is involved.				
I am able to explain how meiosis halves the number of chromosomes in gametes and fertilisation restores the full number of chromosomes.				
Cells in reproductive organs divide by meiosis to form gametes. When a cell divides to form gametes: • copies of the genetic information are made • the cell divides twice to form four gametes, each with a single set of chromosomes • all gametes are genetically different from each other.				
Gametes join at fertilisation to restore the normal number of chromosomes. The new cell divides by mitosis. The number of cells increases. As the embryo develops cells differentiate.				
(Knowledge of the stages of meiosis is not required.)				

Advantages of asexual reproduction: • only one parent needed • more time and energy efficient as do not need to find a mate • faster than sexual reproduction • many identical offspring can be produced when conditions are favourable.				
Some organisms reproduce by both methods depending on the circumstances. • Malarial parasites reproduce asexually in the human host, but sexually in the mosquito. • Many fungi reproduce asexually by spores but also reproduce sexually to give variation. • Many plants produce seeds sexually, but also reproduce asexually by runners such as strawberry plants, or bulb division such as daffodils.				
Knowledge of reproduction in organisms is restricted to those mentioned.				
Students are expected to be able to explain the advantages and disadvantages of asexual and sexual reproduction for any organism if given appropriate information.				
Students should be able to describe the structure of DNA and define genome.				
The genetic material in the nucleus of a cell is composed of a chemical called DNA. DNA is a polymer made up of two strands forming a double helix. The DNA is contained in structures called chromosomes.				
A gene is a small section of DNA on a chromosome. Each gene codes for a particular sequence of amino acids, to make a specific protein.				
The genome of an organism is the entire genetic material of that organism. The whole human genome has now been studied and this will have great importance for medicine in the future.				
I am able to discuss the importance of understanding the human genome. This is limited to the:				

• search for genes linked to different types of disease • understanding and treatment of inherited disorders • use in tracing human migration patterns from the past.				
Students should be able to describe DNA as a polymer made from four different nucleotides. Each nucleotide consists of a common sugar and phosphate group with one of four different bases attached to the sugar.				
DNA contains four bases, A, C, G and T.				
A sequence of three bases is the code for a particular amino acid. The order of bases controls the order in which amino acids are assembled to produce a particular protein.				
The long strands of DNA consist of alternating sugar and phosphate sections. Attached to each sugar is one of the four bases.				
The DNA polymer is made up of repeating nucleotide units.				
Higher Tier only: I am able to: • recall a simple description of protein synthesis • explain simply how the structure of DNA affects the protein made • describe how genetic variants may influence phenotype: a) in coding DNA by altering the activity of a protein: and b) in non-coding DNA by altering how genes are expressed.				
(HT only) In the complementary strands a C is always linked to a G on the opposite strand and a T to an A.				
(HT only) Students are not expected to know or understand the structure of mRNA, tRNA, or the detailed structure of amino acids or proteins.				
(HT only) Students should be able to explain how a change in DNA structure may result in a change in the protein synthesised by a gene.				
(HT only) Proteins are synthesised on ribosomes, according to a template. Carrier molecules bring specific amino acids to add to the growing protein chain in the correct order.				

(HT only) When the protein chain is complete it folds up to form a unique shape. This unique shape enables the proteins to do their job as enzymes, hormones or forming structures in the body such as collagen.				
(HT only) Mutations occur continuously. Most do not alter the protein, or only alter it slightly so that its appearance or function is not changed.				
(HT only) A few mutations code for an altered protein with a different shape. An enzyme may no longer fit the substrate binding site or a structural protein may lose its strength.				
(HT only) Not all parts of DNA code for proteins. Non-coding parts of DNA can switch genes on and off, so variations in these areas of DNA may affect how genes are expressed.				
I am able to explain the terms: • gamete • chromosome • gene • allele • dominant • recessive • homozygous • heterozygous • genotype • phenotype.				
Some characteristics are controlled by a single gene, such as: fur colour in mice; and red-green colour blindness in humans. Each gene may have different forms called alleles.				
The alleles present, or genotype, operate at a molecular level to develop characteristics that can be expressed as a phenotype.				
A dominant allele is always expressed, even if only one copy is present. A recessive allele is only expressed if two copies are present (therefore no dominant allele present).				

If the two alleles present are the same the organism is homozygous for that trait, but if the alleles are different they are heterozygous.				
Most characteristics are a result of multiple genes interacting, rather than a single gene.				
I understand the concept of probability in predicting the results of a single gene cross, but can recall that most phenotype features are the result of multiple genes rather than single gene inheritance.				
I am able to use direct proportion and simple ratios to express the outcome of a genetic cross.				
Students should be able to complete a Punnett square diagram and extract and interpret information from genetic crosses and family trees.				
(HT only) Students should be able to construct a genetic cross by Punnett square diagram and use it to make predictions using the theory of probability.				
Some disorders are inherited. These disorders are caused by the inheritance of certain alleles. • Polydactyly (having extra fingers or toes) is caused by a dominant allele. • Cystic fibrosis (a disorder of cell membranes) is caused by a recessive allele.				
I can make informed judgements about the economic, social and ethical issues concerning embryo screening, given appropriate information.				
Ordinary human body cells contain 23 pairs of chromosomes.				
22 pairs control characteristics only, but one of the pairs carries the genes that determine sex. • In females the sex chromosomes are the same (XX). • In males the chromosomes are different (XY).				
I am able to carry out a genetic cross to show sex inheritance.				
I understand and can use direct proportion and simple ratios in genetic crosses.				

I am able to describe simply how the genome and its interaction with the environment influence the development of the phenotype of an organism.				
Differences in the characteristics of individuals in a population is called variation and may be due to differences in: • the genes they have inherited (genetic causes) • the conditions in which they have developed (environmental causes) • a combination of genes and the environment.				
I am able to: • state that there is usually extensive genetic variation within a population of a species • recall that all variants arise from mutations and that: most have no effect on the phenotype; some influence phenotype; very few determine phenotype.				
Mutations occur continuously. Very rarely a mutation will lead to a new phenotype. If the new phenotype is suited to an environmental change it can lead to a relatively rapid change in the species.				
I am able to describe evolution as a change in the inherited characteristics of a population over time through a process of natural selection which may result in the formation of a new species.				
The theory of evolution by natural selection states that all species of living things have evolved from simple life forms that first developed more than three billion years ago.				
Students should be able to explain how evolution occurs through natural selection of variants that give rise to phenotypes best suited to their environment.				
If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species.				
I am able to explain the impact of selective breeding of food plants and domesticated animals.				
Selective breeding (artificial selection) is the process by which humans breed plants and animals for particular genetic characteristics. Humans have been doing this for thousands of				

years since they first bred food crops from wild plants and domesticated animals.				
Selective breeding involves choosing parents with the desired characteristic from a mixed population. They are bred together. From the offspring those with the desired characteristic are bred together. This continues over many generations until all the offspring show the desired characteristic.				
The characteristic can be chosen for usefulness or appearance: • Disease resistance in food crops. • Animals which produce more meat or milk. • Domestic dogs with a gentle nature. • Large or unusual flowers.				
Selective breeding can lead to 'inbreeding' where some breeds are particularly prone to disease or inherited defects.				
I am able to describe genetic engineering as a process which involves modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic.				
Plant crops have been genetically engineered to be resistant to diseases or to produce bigger better fruits.				
Bacterial cells have been genetically engineered to produce useful substances such as human insulin to treat diabetes.				
Students should be able to explain the potential benefits and risks of genetic engineering in agriculture and in medicine and that some people have objections.				
In genetic engineering, genes from the chromosomes of humans and other organisms can be 'cut out' and transferred to cells of other organisms.				
Crops that have had their genes modified in this way are called genetically modified (GM) crops. GM crops include ones that are resistant to insect attack or to herbicides. GM crops generally show increased yields.				
Concerns about GM crops include the effect on populations of wild flowers and insects. Some people feel the effects of eating GM crops on human health have not been fully explored.				
Modern medical research is exploring the possibility of genetic modification to overcome some inherited disorders.				

Higher Tier only: I am able to describe the main steps in the process of genetic engineering.				
Higher Tier only: In genetic engineering: • enzymes are used to isolate the required gene; this gene is inserted into a vector, usually a bacterial plasmid or a virus • the vector is used to insert the gene into the required cells • genes are transferred to the cells of animals, plants or microorganisms at an early stage in their development so that they develop with desired characteristics.				
Tissue culture: using small groups of cells from part of a plant to grow identical new plants. This is important for preserving rare plant species or commercially in nurseries.				
Cuttings: an older, but simple, method used by gardeners to produce many identical new plants from a parent plant.				
Embryo transplants: splitting apart cells from a developing animal embryo before they become specialised, then transplanting the identical embryos into host mothers.				
Adult cell cloning: • The nucleus is removed from an unfertilised egg cell. • The nucleus from an adult body cell, such as a skin cell, is inserted into the egg cell. • An electric shock stimulates the egg cell to divide to form an embryo. • These embryo cells contain the same genetic information as the adult skin cell. • When the embryo has developed into a ball of cells, it is inserted into the womb of an adult female to continue its development.				
Charles Darwin, as a result of observations on a round the world expedition, backed by years of experimentation and discussion				

and linked to developing knowledge of geology and fossils, proposed the theory of evolution by natural selection. • Individual organisms within a particular species show a wide range of variation for a characteristic. • Individuals with characteristics most suited to the environment are more likely to survive to breed successfully. • The characteristics that have enabled these individuals to survive are then passed on to the next generation.				
Darwin published his ideas in *On the Origin of Species* (1859). There was much controversy surrounding these revolutionary new ideas.				
The theory of evolution by natural selection was only gradually accepted because: • the theory challenged the idea that God made all the animals and plants that live on Earth • there was insufficient evidence at the time the theory was published to convince many scientists • the mechanism of inheritance and variation was not known until 50 years after the theory was published.				
Other theories, including that of Jean-Baptiste Lamarck, are based mainly on the idea that changes that occur in an organism during its lifetime can be inherited. We now know that in the vast majority of cases this type of inheritance cannot occur.				
A study of creationism is not required.				
Wallace worked worldwide gathering evidence for evolutionary theory. He is best known for his work on warning colouration in animals and his theory of speciation.				
Alfred Wallace did much pioneering work on speciation but more evidence over time has led to our current understanding of the theory of speciation.				
I am able to describe the steps which give rise to new species.				
I am able to: • describe the development of our understanding of genetics including the work of Mendel				

• understand why the importance of Mendel's discovery was not recognised until after his death.				
In the mid-19th century Gregor Mendel carried out breeding experiments on plants. One of his observations was that the inheritance of each characteristic is determined by 'units' that are passed on to descendants unchanged.				
In the late 19th century behaviour of chromosomes during cell division was observed.				
In the early 20th century it was observed that chromosomes and Mendel's 'units' behaved in similar ways. This led to the idea that the 'units', now called genes, were located on chromosomes.				
In the mid-20th century the structure of DNA was determined and the mechanism of gene function worked out.				
This scientific work by many scientists led to the gene theory being developed.				
Students should be able to describe the evidence for evolution including fossils and antibiotic resistance in bacteria.				
The theory of evolution by natural selection is now widely accepted.				
Evidence for Darwin's theory is now available as it has been shown that characteristics are passed on to offspring in genes. There is further evidence in the fossil record and the knowledge of how resistance to antibiotics evolves in bacteria.				
Fossils are the 'remains' of organisms from millions of years ago, which are found in rocks.				
Fossils may be formed: • from parts of organisms that have not decayed because one or more of the conditions needed for decay are absent • when parts of the organism are replaced by minerals as they decay • as preserved traces of organisms, such as footprints, burrows and rootlet traces.				
Many early forms of life were soft-bodied, which means that they have left few traces behind. What traces there were have been mainly destroyed by geological activity. This is why scientists cannot be certain about how life began on Earth.				

We can learn from fossils how much or how little different organisms have changed as life developed on Earth.				
I am able to extract and interpret information from charts, graphs and tables such as evolutionary trees.				
Extinctions occur when there are no remaining individuals of a species still alive.				
Students should be able to describe factors which may contribute to the extinction of a species.				
Bacteria can evolve rapidly because they reproduce at a fast rate.				
Mutations of bacterial pathogens produce new strains. Some strains might be resistant to antibiotics, and so are not killed. They survive and reproduce, so the population of the resistant strain rises. The resistant strain will then spread because people are not immune to it and there is no effective treatment.				
MRSA is resistant to antibiotics.				
To reduce the rate of development of antibiotic resistant strains: • doctors should not prescribe antibiotics inappropriately, such as treating non-serious or viral infections • patients should complete their course of antibiotics so all bacteria are killed and none survive to mutate and form resistant strains • the agricultural use of antibiotics should be restricted.				
The development of new antibiotics is costly and slow. It is unlikely to keep up with the emergence of new resistant strains.				
Traditionally living things have been classified into groups depending on their structure and characteristics in a system developed by Carl Linnaeus.				
Linnaeus classified living things into kingdom, phylum, class, order, family, genus and species. Organisms are named by the binomial system of genus and species.				
Students should be able to use information given to show understanding of the Linnaean system.				
Students should be able to describe the impact of developments in biology on classification systems.				
As evidence of internal structures became more developed due to improvements in microscopes, and the understanding of				

biochemical processes progressed, new models of classification were proposed.				
Due to evidence available from chemical analysis there is now a 'three domain system' developed by Carl Woese. In this system organisms are divided into: • archaea (primitive bacteria usually living in extreme environments) • bacteria (true bacteria) • eukaryota (which includes protists, fungi, plants and animals).				
Evolutionary trees are a method used by scientists to show how they believe organisms are related. They use current classification data for living organisms and fossil data for extinct organisms.				
	Red	**Amber**	**Green**	**Revised** Tick ☑
Area of Study: Ecology				
I can recall what an ecosystem is				
I can describe which resources animals and plants compete for, and why they do this				
I can explain the terms 'interdependence' and 'stable community'				
I can name some abiotic and biotic factors that affect communities				
I can explain how a change in an abiotic or biotic factor might affect a community				
I can describe structural, behavioural and functional adaptations of organisms				
I can describe what an extremophile is				
I can represent the feeding relationships within a community using a food chain and describe these relationships				
I can explain how and why ecologists use quadrats and transects				
I can describe and interpret predator-prey cycles				
I have done Required practical 9: measure the population size of a common species in a habitat. Use sampling to investigate the effect of one factor on distribution				

I can describe the processes involved in the carbon cycle				
I can describe the processes involved in the water cycle				
I can explain how temperature, water and availability of oxygen affect the rate of decay of biological material				
I can explain how the conditions for decay are optimised by farmers and gardeners, and the reasons for this				
I can describe how methane gas can be produced from decaying materials for use as a fuel				
I have done: Required practical 10: investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change				
I can explain how environmental changes can affect the distribution of species in an ecosystem (temperature, water and atmospheric gases)				
I can describe what biodiversity is, why it is important, and how human activities affect it				
I can describe the impact of human population growth and increased living standards on resource use and waste production				
I can explain how pollution can occur, and the impacts of pollution				
I can describe how humans reduce the amount of land available for other animals and plants				
I can explain the consequences of peat bog destruction				
I can describe what deforestation is and why it has occurred in tropical areas				
I can explain the consequences of deforestation				
I can describe how the composition of the atmosphere is changing, and the impact of this on global warming				
I can describe some biological consequences of global warming				
I can describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity				
I can describe programmes that aim to reduce the negative effects of humans on ecosystems and biodiversity				

PERSONALISED LEARNING CHECKLISTS

I can describe the different trophic levels and use numbers and names to represent them				
I can describe what decomposers are and what they do				
I can construct a pyramids of biomass accurately from data and explain what they represents				
I can state how much energy producers absorb from the Sun and how much biomass is transferred				
I can explain how biomass is lost between trophic levels, including the consequences of this and calculate efficiency between trophic levels				
I can explain the term 'food security' and describe biological factors that threaten it				
I can explain how the efficiency of food production can be improved				
I can explain the term 'factory farming', including examples, and ethical objections				
I can explain the importance of maintaining fish stocks at a level where breeding continues				
I can explain some methods that can help to conserve fish stocks				
I can describe how modern biotechnology is used in food production, including the fungus Fusarium as an example				
I can describe the uses of genetically modified organisms in insulin and food production				