

Subject: Biology      Year:11      Ability: All

Topic	Inheritance, Variation and Evolution	Ecology	RETEACH and Public Examination Period
Topic overview Pupils will learn...	<p>This section will then look at DNA, chromosomes, mutations and other aspects of genetics which will then explore variation and how that leads to evolution. Variation generated by mutations and sexual reproduction is the basis for natural selection; this is how species evolve. An understanding of these processes has allowed scientists to intervene through selective breeding to produce livestock with favoured characteristics.</p>	<p>This section will now look at how the Sun is a source of energy that passes through ecosystems. Students will link this to how materials including carbon and water are continually recycled by the living world, being released through respiration of animals, plants and decomposing microorganisms and taken up by plants in photosynthesis. An understanding of how all species live in ecosystems composed of complex communities of animals and plants dependent on each other and that are adapted to particular conditions, both abiotic and biotic is an important underlying theme of this topic.</p> <p>Students will learn how in order to continue to benefit from ecosystems, humans need to engage with the environment in a sustainable way. In this section we will explore how humans are threatening biodiversity as well as the natural systems that support it. We will also consider some actions we need to take to ensure our future health, prosperity and well-being.</p>	
What Golden Knowledge will pupils learn and remember?	<p>In this topic on inheritance, students will explain why sexual reproduction produces variation in the offspring, but asexual reproduction does not. Students can link this back to cells and mitosis. Students will then be able to describe sexual reproduction in animals and plants and then define the term clone. This knowledge will help students to describe cuttings as clones of plants. Students will revisit cell division from Year 9 and link this to the process of Meiosis.</p> <p>Linking back to cell division, students will be able to explain the number of chromosomes in the gametes during meiosis and fertilisation and then describe how an embryo is formed.</p> <p><b>Triple students will then be able to compare mitosis and meiosis and describe advantages and disadvantages of sexual and asexual reproduction.</b> Students will then use their knowledge of genes and alleles to explain using a Punnett square and genetic diagram how sex is determined in humans. This will enable students to describe the structure of chromosomes, DNA and genes and describe what the genome is. <b>This will help triple students describe the structure of DNA using diagrams and models and describe in simple terms how a protein is synthesised. This then links to the importance of the shape of a protein for enzyme action</b></p> <p><b>Triple students will then use their knowledge of DNA to describe what a mutation is and how a mutation could affect the formation of a protein. This will help students describe the function of non-coding parts of DNA and the possible effect of a mutation in a non-coding section of DNA</b></p> <p>Knowledge of DNA and genes will enable students to give examples of characteristics controlled by a single gene and describe their alleles. Students will then link this to the definitions for: gametes, genotype, phenotype, dominant recessive, homozygous and heterozygous.</p>	<p>Students will understand and use the terms ecosystem, community, competition, habitat, interdependence in order to describe factors that affect the survival of organisms in their habitat. This will then enable students to explain how one species depends on others for survival.</p> <p>Students will then link this to describe a stable community as one where all the species and environmental factors are in balance, so population sizes remain fairly constant which will enable students to give an example of a stable community. Once students have learnt this, they will be able to describe resources that plants and animals compete for in a given habitat. This then links to students being able to name biotic factors in a habitat and explain how a change in a biotic factor might affect a community, eg:</p> <ul style="list-style-type: none"> <li>• availability of food</li> <li>• new predators arriving</li> <li>• new disease organisms</li> <li>• one species out-competing another so the numbers are no longer sufficient to breed.</li> </ul> <p>Once students have named biotic factors, they will be able to name abiotic factors in a habitat and explain how a change in a biotic factor might affect a community, eg:</p> <ul style="list-style-type: none"> <li>• light intensity</li> <li>• temperature</li> <li>• moisture levels</li> <li>• soil pH and mineral content</li> <li>• wind intensity and direction</li> <li>• carbon dioxide levels for plants</li> <li>• oxygen levels for aquatic animals</li> </ul> <p>Once students have a fundamental knowledge of ecosystems, they will then be able to describe how to carry out random sampling of organisms using a quadrat and describe when and how a transect should be used. Students will build upon this by then explaining why sample size is important to obtain valid results.</p>	

Students will then use this knowledge to describe the inherited disorders polydactyly and cystic fibrosis and to discuss the use of genetic modification to treat genetic disorders.

Triple students will use knowledge learnt about genetics to describe some of the experiments carried out by Mendel using pea plants. Students will then use this knowledge to learn that Mendel proposed the idea of separately inherited factors and why the importance of this discovery was not recognised until after his death.

To build upon knowledge of genetics, students will define the term genetic engineering and then to explain the process of genetic engineering and its advantages.

Triple students will then link their learning to asexual reproduction to define the term clone. This will then link to describing plant cloning techniques such as taking plant cuttings and tissue culture. This will enable students to explain the importance of cloning to plant growers. Students will then link this to the advantages and disadvantages of plant cloning techniques. Once students have learnt about plant cloning, this will help them explain why identical twins are clones.

Students will learn about animal cloning techniques to include; embryo transplants and adult cell cloning.

This will then enable students to present arguments for and against human cloning and to make informed judgements about the economic, social and ethical issues concerning cloning.

Once students have fully understood genetics, students will link this to classifying characteristics as being due to genetic, environmental or a combination of these causes. Students will then be able to give examples of continuous and discontinuous variation.

Students will use knowledge of genetics to explain why humans selectively breed plants and animals. Students will then describe selective breeding as a type of sexual reproduction linking back to earlier in the topic. Students will learn how to describe the process of selective breeding and give examples which will enable them to explain the benefits and risks of selective breeding in plants and animals.

Once students have learnt about variation and genetics, they will then describe Darwin's theory of evolution by natural selection and then be able to describe the main stages of natural selection as.

Students will then have a small block of reteach for paper 1 content in order to prepare them for their Paper 1 examinations next half term.

Students will use their knowledge of genetics to define the term mutation. Students will then link this to explain why mutation may lead to more rapid change in a species. Students will be able to define the term species which will then enable them to identify organisms that are of different species. Students will be able to interpret evolutionary trees to link their knowledge of species.

Triple students will learn about the work of Wallace before learning about Darwin which will help them understand the process of evolution. This will help students explain how new species arise using the terms: isolation, genetic variation and natural selection.

Students will then describe and explain how structural, behavioural and functional adaptations, in a range of organisms, help them to survive in their habitat and then use this knowledge to define the term extremophile and give general examples.

Linking back to KS3 learning, students will be reminded what a food chain shows and then use this knowledge to explain that photosynthetic organisms are the producers of biomass for life on Earth. This will enable students to identify producers, primary, secondary and tertiary consumers in a food chain and subsequently explain the terms: producer, consumer, decomposer, herbivore, carnivore and omnivore.

Students will then link this to how decomposers secrete external enzymes to digest dead plants and animals, then the small molecules diffuse into the microorganism. Triple students will build upon this to identify the trophic levels on food chains and pyramids of biomass and then use this knowledge to explain what losses of biomass are due to.

All students will link their knowledge of ecosystems in order to explain the importance of the carbon cycle and the water cycle to living things.

Triple students will then explain the role of microorganisms in cycling materials through an ecosystem and use this knowledge to describe the factors which affect the rate of decay as:

- temperature
- availability of oxygen
- availability of moisture
- availability of microorganisms to carry out decay
- pH
- build-up of toxic substances.

Triple students will use their knowledge of decay and decomposers learnt last half term to explain how decay is useful to plants. This will then enable students to describe how gardeners and farmers try to provide optimum conditions for rapid decay of wastes. Students will then be able to explain the difference between aerobic and anaerobic decay using their knowledge from bioenergetics. Once students understand anaerobic decay, they will be able to define the term biogas. This will then enable students to explain why the output from a biogas generator is affected by climatic conditions.

Linking back to ecosystems, all students will need to define the term biodiversity and then use this knowledge to explain how great biodiversity maintains food supplies and shelter for organisms, and maintains the physical environment. This will then enable students to describe examples of how a reduction in biodiversity can affect climate, food supplies for humans, useful chemical for the future etc.

Once students have learnt about biodiversity, this leads on to describing the problems associated with an increasing human population and then subsequently how water can be polluted with sewage, fertiliser or toxic chemicals. This will enable students to describe examples of air pollutants and where they come from and then describe the effects of smoke on buildings, humans and plant photosynthesis. Students will then build upon this knowledge in order to describe how acid rain is formed and the effects of acid rain on living organisms.

Students will then describe what herbicides and pesticides are used for, what peat is and why it is important to preserve areas of peat. This will then enable students to explain why peat should not be burnt.

Once students have a great understanding of ecosystems and biodiversity, students will move on to learn about deforestation. This will enable students to explain why vast tropical areas have been cleared of trees. This will then allow students to explain how deforestation increases the amount of carbon dioxide in the atmosphere and leads to a reduction in biodiversity. Building upon prior knowledge, students will explain the terms greenhouse effect and global warming. This then will allow them to explain with the aid of a diagram how levels of carbon dioxide and methane contribute to global warming. Once students have the fundamental knowledge of global warming, they will be able to describe the possible effects of global warming.

Building upon students' knowledge of biodiversity, students will describe programmes introduced to maintain biodiversity such as;

	<p>Triple students will then state when Darwin published his theory and explain why it was only gradually accepted. This will then help students describe the work of Alfred Russel Wallace on natural selection and to then link these 2 theories together. To develop students' knowledge further, students will describe the work of Jean-Baptiste Lamarck and then identify differences between Darwin's theory of evolution and conflicting theories.</p> <p>This will then help students to suggest reasons for the different theories. These theories will then enable students to explain the terms inherited and acquired characteristics.</p> <p>Students will describe the evidence for the theory of evolution by natural selection and then link this to the term 'fossil'. This will then enable them to learn about how fossils may be formed. This will then link to explain why scientists cannot be certain how life began on Earth and how fossils provide evidence for evolution.</p> <p>Students will explain what we should do to slow down the rate of development of resistant strains of bacteria and link their knowledge to evolution and then this will help them to describe the impact of antibiotic resistance.</p> <p>Students will define the term extinction and then explain how extinction may be caused. This will enable students to explain that organisms become extinct because something changes and the species cannot adapt quickly enough to the new circumstances.</p> <p>Extinction then links to classification and how we classify organisms based on their similarities.</p> <p>Students will use that knowledge to help them use these key taxons; Kingdom, Phylum, Class, Order, Family, Genus Species. Students will then be able to explain the importance of the binomial system to name organisms and link this to explain how modern technologies have affected how organisms are classified today. This will help students understand Carl Woese's system of classification and classify organisms into the three domains.</p>	<p>breeding programmes for endangered species, protection and regeneration of rare habitats, eg coral reefs, mangroves, heathland, reintroduction of field margins and hedgerows in agricultural areas, reduction of deforestation and carbon dioxide emissions by some governments and recycling resources rather than dumping waste in landfill.</p> <p>Triple students will build upon this knowledge in order to explain the possible impact of each environmental change on the distribution of species in an ecosystem and then use this knowledge to explain how factors affect food production and food security locally and globally.</p> <p>Triple students will then be able to explain how restricting the movement of animals and controlling the temperature of their surroundings improves efficiency of food production. This will allow them to define the term factory farming and give examples of animals farmed in this way. Triple students will then explain why some fish stocks are declining and why this is a problem and then subsequently use this knowledge to describe ways that fish stocks can be conserved. Students will then be able to give an example of sustainable food production. Students will then describe how microorganisms can be grown in large vats to produce useful products which will then enable students to explain how the conditions in the vat are monitored and controlled for optimal growth.</p> <p>Linked to this, triple students will describe how the fungus Fusarium can be grown to produce mycoprotein that can be eaten.</p>	
<p>What prior knowledge should pupils already know?</p>	<p>Students have already learnt about the structure of DNA and chromosomes including sexual and asexual reproduction. Students have already learnt about some genetic diseases and how alleles are inherited from one generation to the next.</p>	<p>Students will have learnt about variation, evolution and inheritance in Year 7 and Year 8. Students will have a deep understanding of genetics and DNA and how genes are inherited. They will also be able to explain how genes are passed on to determine characteristics in offspring. Students have already learnt about Darwin's theory of evolution and natural selection. They will have learnt about the fundamentals of genetics including scientific processes involving the development of our genetics understanding.</p>	
<p>What skills will pupils learn and apply? (disciplinary knowledge)</p>	<p>Triple students will predict and explain the outcome of crosses using genetic diagrams based on Mendel's experiments and using unfamiliar information.</p> <p>Students will use evaluation skills to explore the use of genetic engineering in medicine, eg in gene therapy and production of hormones and some vaccines.</p> <p>Students will use their evaluation skills learnt throughout the course to look into the different theories of evolution and why some people didn't accept certain theories.</p>	<p>Triple students will use their mathematical skills to calculate the efficiency of biomass transfer between trophic levels.</p> <p>Students will use evaluation skills to evaluate data gathered by using a quadrat and transect and this will then link to being able to calculate area, mean, median, mode and range</p> <p>Students will plan and carry out a valid method to estimate a plant population and then present and analyse the results.</p> <p>Students will use the transferable skills learnt throughout the course to then interpret and explain population curves, eg hare and lynx, red and grey squirrels, and native and American crayfish.</p>	

		Triple students will use skills learnt to interpret data showing how factors affect the rate of decay which will then enable them to calculate the rate of decay using data. Students will then use these skills to interpret and explain the processes in diagrams of the carbon, water and decay cycles.	
Key vocabulary pupil will know and learn	Selective Breeding Genes Variation Alleles DNA Chromosomes Selective Breeding Darwin Evolution Natural Selection	Communities Abiotic/biotic factors Adaptations Levels of organisation habitat quadrats Carbon and water cycles Decomposition Deforestation	
How will pupil understanding be checked &/or assessed?	Each school in the Trust follows the same assessment cycle process. All students will complete an informal key piece assessment every half term (at least) which take a variety of formats to assess golden knowledge learnt over the previous lessons. The key piece assessments are either retrieval-based questions to help students retrieve their prior golden knowledge, scientific literacy questions where students have to practice applying their golden knowledge to exam style questions in different contexts or exam style questions using a variety of command words such as describe, explain and evaluate. Students will then complete a short improvement activity based on gaps identified in the informal key piece and teachers will check these to ensure gaps have closed. In addition to these informal key piece assessments, all students complete a formal assessment at least every term which synoptically assess their retention and application of key golden knowledge learnt in Biology, Chemistry and Physics. Teachers will then use the Science Trust QLA tracker to identify gaps in knowledge; reteach accordingly and then students will complete a range of improvement style activities to close those gaps which are then checked by the teacher either through live marking or collection of books. Further details of the Science SHARE Assessment and Feedback policy can be found here: <a href="#">Q of E</a>		
Resources available	<p>Each school has their own shared area for each year group in each key stage. Lessons are planned to follow the SHARE Science lesson structure guidance document which can be found here: <a href="#">SCIENCE SHARE MAT lesson structure guidance.docx</a></p> <p>In summary:</p> <ol style="list-style-type: none"> <li>1. First 5/Do Now to retrieve prior learning needed for the foundations of new learning.</li> <li>2. I do/explicit instruction/guided explanation/teacher input through expert curriculum delivery.</li> <li>3. We do/modelling where appropriate to show students how to remember and apply the key golden knowledge to different contexts.</li> <li>4. You do/Independent practice to retrieve and practice applying the key golden knowledge to a variety of contexts.</li> <li>5. Final 5 to retrieve key golden knowledge learnt in the lesson.</li> </ol> <p>All schools have these SHARE Science curriculum plans, delivery plans which sit underneath these to guide staff on when to deliver each section of the curriculum and then schemes of learning and lesson resource folders to adapt in order to meet the unique needs of the students and classes they teach. All shared resources which are common across all schools can be found in the SHARE Science folder here: <a href="#">Home</a> (click on the documents tab at the top of the page)</p> <p>All QA including lesson visits, work scrutiny and student voice will prioritise the SHARE Science Q of E Non-Negotiables Checklist which can be found here: <a href="#">SCIENCE SHARE MAT Non negotiables Q of E QA check list.docx</a></p> <p>All lesson resources are focussed on retrieval (through the Retrieve to Remember strategy) and practice, and this is built into these curriculum plan through effective sequencing of golden knowledge components.</p> <p>There are also KS3 and KS4 Golden Knowledge booklets for staff which outline the key golden knowledge linked to the exam specifications and National Curriculum at KS3 and KS4. These can be found here: <a href="#">Golden Knowledge</a></p> <p>If staff can't get access to any of the folders above, please request access through <a href="mailto:joanna.richards@sharemat.co.uk">joanna.richards@sharemat.co.uk</a></p>		
Notes	In order for students to understand natural selection and how this leads to evolution, students must understand gene mutations and how they occur continuously and on rare occasions can affect the functioning of the animal	All students need a fundamental knowledge of ecosystems and biodiversity in order to understand how humans can impact on the environment and how we can help with food security and sustainability. All of this impacts on students and their future in terms of global warming, the environment, food security, biodiversity and how this	

Why this topic is important...

or plant. They need to understand that variation generated by mutations and sexual reproduction is the basis for natural selection; this is how species evolve.  
Leading on from last topic, students will need an understanding of these genetic processes and how this has allowed scientists to intervene through selective breeding to produce livestock with favoured characteristics. This will enable students to understand how scientists have now discovered how to take genes from one species and introduce them in to the genome of another by a process called genetic engineering. Students can then use this knowledge to evaluate the huge potential benefits that this technology can offer but how genetic modification still remains highly controversial.

can impact on their future generations. This topic also links very well to Topic 6 where students learn about genetics, adaptations and how this causes species to evolve.

