

TITLE: B6 Inheritance, Variation and Evolution

Unit Overview

In this topic, students will develop their understanding of inheritance, variation and evolution, exploring how genetic information is stored in DNA and passed from one generation to the next. Students will learn how genes, chromosomes and genomes are linked, how sexual and asexual reproduction contribute to inheritance, and how mitosis and meiosis produce new cells and genetic variation. They will use genetic diagrams and Punnett squares to predict inheritance patterns and investigate how variation arises through both genetic and environmental factors. Students will explore how selective breeding and genetic engineering can alter characteristics in plants and animals, and evaluate the associated scientific, social and ethical issues. The topic also develops understanding of Darwin's theory of evolution by natural selection, the role of mutations in evolutionary change, the evidence provided by fossils, the development of antibiotic resistance, and how modern classification systems organise living organisms according to evolutionary relationships. Throughout the unit, students will apply scientific evidence, data interpretation and critical thinking to explain biological change over time and evaluate developments in genetics and biotechnology.

Prior Learning

This topic builds on students' prior understanding of cells, reproduction and disease, developed throughout KS3 and earlier GCSE Biology topics. Students have previously learnt that genetic information is stored within the nucleus of cells and is carried on chromosomes made of DNA. They have studied sexual and asexual reproduction, fertilisation, cell division and the role of specialised cells in growth and development. In GCSE Biology B1, students explored cell structure, differentiation and how genetic information controls cell activities. In B3, students learnt about pathogens, natural selection and the development of antibiotic resistance, providing an introduction to evolutionary processes. This prior knowledge provides the foundation for understanding how characteristics are inherited, how variation arises within populations, how evolution occurs through natural selection, and how modern genetic technologies such as selective breeding and genetic engineering can influence organisms over time.

Future Learning (KS5)

At A Level Biology, students will build on their knowledge of inheritance, variation and evolution by studying genetics in much greater depth. Students will investigate the structure and function of DNA, how genes control the production of proteins, and how genetic information is inherited and expressed within cells. They will explore patterns of inheritance using more complex genetic crosses and learn how mutations can influence gene function and contribute to genetic diversity.

Students will further develop their understanding of evolution and natural selection by examining population genetics, speciation and the mechanisms that lead to the formation of new species. They will investigate how environmental pressures influence allele frequencies within populations and how evolutionary change can be measured over time.

Students will also study modern biotechnology and genetic technologies, including genome sequencing, gene editing and the use of genetic engineering in medicine, agriculture and industry. Throughout the course, students will apply scientific evidence, data analysis and critical evaluation skills to explain biological change, assess ethical issues and evaluate the impact of developments in genetics and evolutionary biology on society.

Misconceptions

B6.01 DNA

- DNA, genes and chromosomes are the same thing.

- A genome is a single gene.
- DNA only exists in humans.
- All genes code directly for visible characteristics.

B6.02 Reproduction

- Sexual reproduction always involves mating.
- Asexual reproduction produces variation.
- Sexual reproduction always produces identical offspring.
- Asexual reproduction is less successful than sexual reproduction in all situations.

B6.03 Mitosis v Meiosis

- Mitosis and meiosis produce the same type of cells.
- Meiosis occurs in all body cells.
- Mitosis creates variation.
- Meiosis is used for growth and repair.

B6.04 Sex Determination and Genetic Diagrams

- Genotype and phenotype mean the same thing.
- Dominant alleles are always the most common.
- Dominant alleles are “stronger” than recessive alleles.
- The mother determines the biological sex of a baby.
- Punnett squares predict exactly what will happen.

B6.05 Embryo Screening and Family Trees

- Embryo screening changes an embryo's genes.
- Embryo screening guarantees a healthy child.
- Family trees only show physical characteristics.
- Science alone determines whether embryo screening should be used.

B6.06 Variation

- All variation is inherited.
- Environmental factors do not affect characteristics.
- Continuous and discontinuous variation are the same.
- Characteristics are caused by either genes or the environment, never both.

B6.07 Selective Breeding

- Selective breeding and genetic engineering are the same process.
- Selective breeding creates new genes.
- Selective breeding only occurs in animals.
- Selective breeding always produces positive outcomes.

B6.08 Genetic Engineering

- Genetically modified organisms are always harmful.
- Genetic engineering guarantees beneficial outcomes.

- Scientists can transfer characteristics without transferring genes.
- Genetic engineering is simply a faster form of selective breeding.

B6.09 Evolution

- Individual organisms evolve during their lifetime.
- Organisms evolve because they need to.
- Mutations are always harmful.
- Evolution has a specific goal or direction.

B6.10 Fossils

- Every organism becomes fossilised after death.
- Fossils provide complete evidence of all past life.
- Fossils prove exactly how life began on Earth.
- Evolution happens suddenly rather than gradually.

B6.11 Antibiotic Resistance

- Antibiotics kill viruses.
- People become resistant to antibiotics.
- Antibiotics cause mutations that create resistance.
- Resistance develops because bacteria choose to adapt.

B6.12 Classification

- Organisms are classified only by appearance.
- Classification systems never change.
- Species and genus mean the same thing.
- Organisms that look similar are always closely related.

Topic-Wide Misconceptions

- All inherited characteristics are controlled by a single gene.
- Variation and evolution are unrelated.
- Evolution only occurred in the distant past.
- Humans cannot influence the genetic characteristics of organisms.
- Scientific explanations remain unchanged once accepted.

Practical Requisitions

Mastery (HPA)

Students explain and justify scientific ideas about inheritance, variation and evolution using evidence from genetic diagrams, data and biological examples. They apply their knowledge of DNA, reproduction and inheritance to unfamiliar situations, analyse patterns in inheritance and variation, and evaluate the benefits, risks and ethical implications of developments such as selective breeding, embryo screening and genetic engineering. Students use scientific evidence to explain evolutionary change, interpret classification systems and construct reasoned arguments using accurate biological vocabulary.

B6.01 DNA		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Define the terms genome, chromosome, gene and DNA - Describe the structure of DNA - Discuss the importance of studying the human genome	Analyse the relationship between DNA, genes, chromosomes and the genome.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific discoveries about DNA have changed biology and medicine. WS 1.2 (Models) Use models and diagrams to represent DNA structure and genetic information. WS 3.6 (Explain using Evidence) Explain inheritance using genetic terminology. WS 4.1 (Scientific Vocabulary) Use terms such as genome, gene, chromosome, DNA and nucleotide accurately.	EEF 4 (Memory): Retrieve prior understanding of chromosomes, genes and heredity from KS3. EEF 3 (Modelling): Model the hierarchy DNA → Gene → Chromosome → Genome using diagrams. EEF 6 (Language): Explicit teaching of specialist genetic vocabulary. EEF 7 (Feedback): Feedback used to improve explanations and application of terminology.
Do Now (5 mins)	Purpose Retrieve KS3 learning about inheritance, chromosomes, genes and DNA. Suggested Structure (teacher adapts) - What is inherited from parents? - What is a chromosome? - What is DNA? Diamond (Challenge) - Why do children usually share characteristics with their parents? Teacher Uses Responses To - Assess understanding of inheritance. - Identify misconceptions about genes and chromosomes. - Establish foundations for GCSE terminology.	Apply knowledge of DNA structure to explain how genetic information is stored. Evaluate the benefits of studying the human genome for medicine and society.		
Hook / Intro (5 mins)	Introduce Key Idea “Every instruction needed to build and maintain your body is stored inside your cells.” Suggested Strategy Display: - DNA double helix image - Chromosome image - Human cell image Ask: - How are these structures connected? - Which one contains the instructions for life? - How much information do you think is stored inside a single cell? Pedagogical Rationale Creates curiosity and introduces the hierarchy of genetic information.		Maths Skills 1c (Classification) Organise biological structures into hierarchical systems. 2h (Order of Magnitude) Consider the scale of DNA and genomes. 4a (Interpretation) Interpret DNA diagrams and genome information.	
Direct	Content: Genetic Information			

Teaching: Cell Structure (10 – 15 mins)	Introduce: DNA • Deoxyribonucleic acid • Molecule that carries genetic information Gene • A section of DNA • Codes for a particular characteristic or protein Chromosome • Long coiled DNA molecule • Found inside the nucleus Genome • The entire genetic material of an organism DNA Structure Introduce: DNA is: • A polymer • Made from nucleotides • Shaped as a double helix Nucleotides Contain: • Sugar • Phosphate • Base Base Pairing Students should know: • A pairs with T • C pairs with G Key Idea The sequence of bases determines genetic information. The Human Genome Project Introduce: Scientists have mapped the human genome. Benefits include: • Understanding inherited disorders • Development of personalised medicine			
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	- Understanding human evolution Limitations: - Ethical concerns - Privacy issues Teacher Modelling (EEF 3) Model hierarchy: Genome → Chromosomes → Genes → DNA → Nucleotides Model explanation: “A gene is a section of DNA. Many genes form a chromosome, and all of the chromosomes together make up the genome.” Check for Understanding (Hinge Point) - What is DNA? - What is a gene? - What is a genome? - What is a chromosome? - What are the four DNA bases? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported vocabulary and hierarchy building. Pupils - Match terms to definitions. - Complete genetic hierarchy diagrams. - Label a DNA structure diagram. Teacher Role - Model first examples. - Reinforce specialist vocabulary. - Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: - Define key terms. - Explain relationships between DNA, genes, chromosomes and genomes. - Label DNA structure. - Explain why studying the human genome is important.			

	Suggested Activities • DNA hierarchy activity • Vocabulary matching task • Human Genome Project reading and analysis • Structured explanation questions Teacher Flexibility Teachers select format based on class need: • Diagram annotation • Card sort • Knowledge organiser completion • GCSE-style application questions Success Criteria • Define genome, chromosome, gene and DNA. • Describe the structure of DNA. • Explain the hierarchy of genetic information. • Describe benefits of genome studies. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Provide labelled DNA diagrams. • Use scaffolded hierarchy diagrams. • Provide keyword support sheets. If secure • Explain how DNA carries information. • Analyse applications of genome projects. • Evaluate ethical issues associated with genetics.			
Support / Diamond (challenge)	Support • Vocabulary mat. • DNA structure scaffold. • Hierarchy flowchart. Example sentence starters: “A gene is _____.” “The genome is _____.” “Studying the genome helps scientists to _____.” Diamond (Challenge)			

	- Evaluate the importance of the Human Genome Project. - Analyse links between genes and inherited disorders. - Explain potential ethical issues related to genetic information.			
Common misconceptions	- DNA and genes are the same thing. - Chromosomes exist outside the nucleus. - The genome refers to a single gene. - Every gene codes directly for a visible characteristic. - DNA contains only two bases.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define DNA. - Define genome. - Explain the difference between a gene and a chromosome. - Complete a DNA structure diagram. Diagnostic Focus Can pupils: - Correctly define key terminology? - Explain relationships between structures? - Describe DNA structure? - Explain the significance of genome studies?			
Exit ticket (5 mins)	Purpose Inform planning for B6.02 Reproduction Example Questions - What is a gene? - What is a genome? - What is DNA made from? Teacher uses responses to identify misconceptions before moving on to sexual and asexual reproduction.			
Adaptive teaching	- Purpose - Inform planning for B6.02 Reproduction - Example Questions - What is a gene? - What is a genome? - What is DNA made from? - Teacher uses responses to identify			

	misconceptions before moving on to sexual and asexual reproduction.			
British Values	Democracy - Students discuss the benefits and implications of genetic research and the Human Genome Project. Individual Liberty - Students evaluate how genetic information may influence future medical decisions.			
Teacher Notes for MTP adaptations				

B3.02 Bacterial, Vural, Fungal and Protist Diseases		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Describe the difference between sexual and asexual reproduction - Explain the difference between mitosis and meiosis	Analyse the advantages and disadvantages of sexual and asexual reproduction.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how different types of reproduction affect variation within populations. WS 1.2 (Models) Use diagrams and models to compare mitosis and meiosis. WS 3.6 (Explain using Evidence) Explain biological processes using scientific knowledge. WS 4.1 (Scientific Vocabulary) Use terms such as sexual reproduction, asexual reproduction, mitosis, meiosis, gamete and variation accurately.	EEF 4 (Memory): Retrieve prior learning about fertilisation, gametes and cell division. EEF 3 (Modelling): Model the differences between mitosis and meiosis using diagrams and comparison tables. EEF 6 (Language): Explicit teaching of specialist reproduction vocabulary. EEF 7 (Feedback): Feedback used to improve explanations and comparisons.
Do Now (5 mins)	Purpose Retrieve prior learning about DNA, genes and chromosomes. Suggested Structure (teacher adapts) - What is DNA? - What is a chromosome? - What is a gene? Diamond (Challenge) - Why do children usually share characteristics with their parents? Teacher Uses Responses To - Assess understanding of inheritance. - Link genes and chromosomes to reproduction. - Prepare pupils for variation and inheritance.	Apply knowledge of mitosis and meiosis to explain how variation arises within a species. Evaluate why sexual reproduction is important for evolution and adaptation.		
Hook / Intro (5 mins)	Introduce Key Idea “Why do offspring sometimes look similar to their parents, but not identical?” Suggested Strategy Display images of: - Parent and offspring animals. - Identical strawberries produced from runners. - Human families. Ask: - Why do some offspring look almost identical? - Why do others show more variation? - Could the way organisms reproduce affect this? Pedagogical Rationale Creates curiosity and establishes the need to compare sexual and asexual reproduction.		Maths Skills 1c (Classification) Classify organisms according to reproductive strategies. 2c (Patterns and Relationships) Identify links between reproduction and variation.	
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Sexual Reproduction Introduce: Sexual Reproduction			

	• Involves two parents. • Involves the fusion of male and female gametes. • Produces genetically varied offspring. Examples: • Humans • Most animals • Flowering plants Key Idea Sexual reproduction increases variation within a population. Variation can increase the chances of survival when environments change. Content: Asexual Reproduction Introduce: Asexual Reproduction • Involves one parent. • No fusion of gametes. • Produces genetically identical offspring (clones). Examples: • Bacteria • Some plants • Some fungi Advantages and Disadvantages Sexual Reproduction Advantages: • Variation • Increased chance of adaptation Disadvantages: • Requires two parents • Slower process Asexual Reproduction Advantages: • Only one parent required • Rapid reproduction Disadvantages:			
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- No variation
- Population may be vulnerable to environmental change

Content: Mitosis and Meiosis

Mitosis

Produces:

- Genetically identical cells

Role:

- Growth
- Repair
- Asexual reproduction

Produces:

- 2 identical daughter cells

Meiosis

Produces:

- Genetically different gametes

Role:

- Sexual reproduction

Produces:

- 4 genetically different gametes

Key Idea

Mitosis creates identical cells.

Meiosis creates variation.

Teacher Modelling (EEF 3)

Model comparison table:

Mitosis	Meiosis
Growth and repair	Produces gametes
2 cells produced	4 cells produced
Cells identical	Cells genetically different

Model explanation:

“Meiosis produces variation because each gamete contains a different combination of genetic information.”

	Check for Understanding (Hinge Point) • What is sexual reproduction? • What is a clone? • Which process produces gametes? • Which process produces genetically identical cells? • Why does meiosis increase variation? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported comparison and classification. Pupils • Complete comparison tables. • Sort examples into sexual or asexual reproduction. • Match mitosis and meiosis to their functions. Teacher Role • Model first examples. • Reinforce key vocabulary. • Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Compare sexual and asexual reproduction. • Explain the roles of mitosis and meiosis. • Describe how variation arises. • Use scientific evidence to explain the advantages and disadvantages of different reproductive strategies. Suggested Activities • Venn diagram comparison • Card sort • Structured explanation task • GCSE-style application questions Teacher Flexibility Teachers select format based on class need: • Comparison table • Diagram annotation • Sequencing activity • Extended written response			

	Success Criteria • Describe sexual and asexual reproduction. • Explain the role of mitosis. • Explain the role of meiosis. • Describe how variation is produced. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Use scaffolded comparison tables. • Provide keyword definitions. • Model sentence construction. If secure • Link variation to evolution. • Analyse unfamiliar reproduction examples. • Explain why sexual reproduction increases diversity.			
Support / Diamond (challenge)	Support • Comparison table scaffold. • Vocabulary mat. • Reproduction flow charts. Example sentence starters: “Sexual reproduction involves _____.” “Mitosis is important because _____.” “Meiosis produces variation because _____.” Diamond (Challenge) • Evaluate whether sexual or asexual reproduction is more advantageous. • Explain why meiosis is essential for evolution. • Apply understanding to unfamiliar organisms.			
Common misconceptions	• Sexual reproduction always involves mating. • Asexual reproduction produces variation. • Mitosis and meiosis produce the same types of cells. • Meiosis occurs in all body cells. • Clones are always identical in appearance.			
Assessment (5	Formative and Summary			

mins)	Quick Check Options • Define sexual reproduction. • Define asexual reproduction. • State one difference between mitosis and meiosis. • Explain why meiosis is important. Diagnostic Focus Can pupils: • Distinguish between reproductive strategies? • Explain mitosis and meiosis? • Use specialist vocabulary accurately? • Link reproduction to variation?			
Exit ticket (5 mins)	Purpose Inform planning for B6.03 Mitosis v Meiosis Example Questions • Which process produces gametes? • Which process produces genetically identical cells? • Why does sexual reproduction produce variation? Teacher uses responses to identify misconceptions before studying mitosis and meiosis in greater depth.			
Adaptive teaching	• Retrieval links DNA and chromosomes to inheritance. • Hinge questions identify misconceptions about reproduction. • Comparison activities reduce cognitive load. • Vocabulary is explicitly taught and revisited. • Challenge develops analytical thinking and links to evolution. • Exit ticket informs progression to cell division.			
British Values	Tolerance - Students recognise that living organisms reproduce in different ways and that different reproductive strategies have advantages in different environments. Individual Liberty - students independently apply scientific knowledge to explain variation and inheritance.			

Teacher Notes for MTP adaptations

B6.03 Mitosis and Meiosis		HPA CHALLENGE	Skills	EEF Recommendations
Learning Objectives	- Describe the difference between sexual and asexual reproduction - Explain the difference between mitosis and meiosis	Analyse how mitosis and meiosis contribute to growth, reproduction and variation.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how different types of cell division contribute to biological processes. WS 1.2 (Models) Use diagrams to compare mitosis and meiosis. WS 3.6 (Explain using Evidence) Explain how cell division contributes to inheritance and variation. WS 3.7 (Evaluation) Evaluate the consequences of different reproductive strategies. WS 4.1 (Scientific Vocabulary) Use terms such as mitosis, meiosis, gamete, chromosome, variation and clone accurately.	EEF 4 (Memory): Retrieve prior learning about sexual and asexual reproduction from B6.02. EEF 3 (Modelling): Model the stages and outcomes of mitosis and meiosis using diagrams. EEF 6 (Language): Explicit teaching of specialist cell division vocabulary. EEF 7 (Feedback): Feedback used to improve comparison and explanation skills.
Do Now (5 mins)	Purpose Retrieve prior learning from B6.02 on reproduction and variation. Suggested Structure (teacher adapts) - What is sexual reproduction? - What is asexual reproduction? - What is a gamete? Diamond (Challenge) - Why are brothers and sisters not genetically identical? Teacher Uses Responses To - Assess understanding of reproduction. - Identify misconceptions about inheritance. - Prepare pupils for comparing mitosis and meiosis.	Apply knowledge of cell division to explain why sexually produced offspring show variation. Evaluate the advantages and disadvantages of sexual and asexual reproduction in different environments.		
Hook / Intro (5 mins)	Introduce Key Idea “How can one process produce identical cells while another produces variation?” Suggested Strategy Display: - Identical strawberries produced by runners. - Human siblings from the same parents. Ask: - Why do the strawberries look almost identical? - Why do siblings often look different? - Could cell division be responsible? Pedagogical Rationale Provides an engaging context for understanding the biological importance of mitosis and meiosis.		Maths Skills 1c (Comparisons) Compare outcomes of mitosis and meiosis. 2c (Patterns and Relationships) Link cell division to patterns of inheritance and variation.	
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Mitosis Introduce: Mitosis			

- Produces genetically identical cells.
- Used for growth, repair and replacement.
- Used in asexual reproduction.

Produces:

- Two genetically identical daughter cells.

Examples

- Skin repair
- Growth of animals
- Asexual reproduction in plants

Content: Meiosis

Introduce:

Meiosis

- Produces gametes.
- Used in sexual reproduction.
- Produces variation.

Produces:

- Four genetically different gametes.

Examples

- Sperm cells
- Egg cells

Comparison Table

Mitosis	Meiosis
Growth and repair	Produces gametes
Two cells produced	Four cells produced
Cells genetically identical	Cells genetically different
Asexual reproduction	Sexual reproduction

Key Idea

Variation occurs during meiosis.

This variation allows populations to adapt and evolve.

Teacher Modelling (EEF 3)

Model explanation:

“Mitosis produces identical cells because the genetic information is copied exactly.”

	“Meiosis produces variation because each gamete receives a different combination of genetic information.” Model comparison writing using evidence. Check for Understanding (Hinge Point) • What is mitosis? • What is meiosis? • Which process produces gametes? • Which process produces genetically identical cells? • Which process produces variation? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported comparison and classification. Pupils • Complete comparison tables. • Sort examples into mitosis or meiosis. • Identify whether examples involve sexual or asexual reproduction. Teacher Role • Model first examples. • Reinforce scientific terminology. • Address misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Compare mitosis and meiosis. • Explain the role of each process. • Link meiosis to variation. • Explain why variation is important. Suggested Activities • Mitosis vs meiosis comparison chart • Card sorting activity • Cause and effect flow diagrams • GCSE-style extended response Teacher Flexibility Teachers select format based on class need: • Comparison table • Diagram annotation			

	- Sequencing activity - Structured explanation task Success Criteria - Define mitosis and meiosis. - Identify the function of each process. - Explain the role of meiosis in producing variation. - Compare sexual and asexual reproduction accurately. - Use scientific vocabulary correctly. Adaptation Prompts If pupils struggle - Use scaffolded comparison tables. - Provide keyword definitions. - Supply worked examples. If secure - Explain links between meiosis, variation and evolution. - Compare reproductive strategies in different organisms. - Apply understanding to unfamiliar examples.			
Support / Diamond (challenge)	Support - Comparison table template. - Vocabulary mat. - Mitosis/meiosis flow diagrams. Example sentence starters: “Mitosis is important because _____. ” “Meiosis is important because _____. ” “Variation occurs because _____. ” Diamond (Challenge) - Evaluate the advantages and disadvantages of sexual and asexual reproduction. - Explain how meiosis contributes to evolution. - Analyse why variation increases the chances of survival in changing environments.			
Common	Mitosis and meiosis produce the same cells.			

misconceptions	• Meiosis occurs in all body cells. • Variation is produced by mitosis. • Sexual reproduction always requires two parents physically present. • Clones are only produced artificially.			
Assessment (5 mins)	Formative and Summary Quick Check Options • Define mitosis. • Define meiosis. • State one difference between the two processes. • Explain why meiosis is important. Diagnostic Focus Can pupils: • Compare mitosis and meiosis accurately? • Explain the role of each process? • Link meiosis to variation? • Use scientific vocabulary correctly?			
Exit ticket (5 mins)	Purpose Inform planning for B6.04 Sex Determination and Genetic Diagrams Example Questions • Which process produces gametes? • Which process produces identical cells? • Why does meiosis increase variation? Teacher uses responses to identify misconceptions before introducing inheritance patterns and genetic diagrams.			
Adaptive teaching	• Retrieval strengthens understanding of reproduction. • Hinge questions identify misconceptions about cell division. • Visual comparison tables reduce cognitive load. • Vocabulary is explicitly taught and revisited. • Challenge develops links between inheritance and evolution. • Exit ticket informs progression to genetics.			
British Values	Democracy - Students justify explanations and compare evidence relating to mitosis, meiosis and reproduction. Individual Liberty - Students independently apply scientific knowledge to explain how variation arises.			

Teacher Notes for MTP adaptations	

B6.04 Sex Determination and Genetic Diagrams		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Define and use the terms gamete, genotype, phenotype, dominant, recessive, homozygous and heterozygous - Complete Punnett squares to predict the outcomes of genetic crosses - Interpret genetic diagrams to determine the probability of inherited characteristics	Analyse genetic diagrams to explain patterns of inheritance. Apply knowledge of genotype and phenotype to unfamiliar genetic crosses. Evaluate the usefulness and limitations of Punnett squares as models of inheritance.	Working Scientifically WS 1.2 (Models) Use Punnett squares as models of genetic inheritance. WS 3.5 (Interpret Data) Interpret information from genetic diagrams and inheritance patterns. WS 3.6 (Explain using Evidence) Explain inheritance using scientific terminology. WS 4.1 (Scientific Vocabulary) Use terms such as genotype, phenotype, dominant, recessive, homozygous and heterozygous accurately. Maths Skills 1c (Probability) Calculate likely outcomes from genetic crosses. 2c (Patterns and Relationships) Identify patterns in inheritance. 4a (Interpretation) Interpret Punnett squares and family inheritance patterns.	EEF 4 (Memory): Retrieve prior learning about DNA, genes, chromosomes and reproduction. EEF 3 (Modelling): Model how to complete Punnett squares and interpret outcomes. EEF 6 (Language): Explicit teaching of specialist genetic vocabulary. EEF 7 (Feedback): Feedback used to improve application of genetic terminology and interpretation of diagrams.
Do Now (5 mins)	Purpose Retrieve prior learning about genes, chromosomes, meiosis and gametes. Suggested Structure (teacher adapts) - What is a gene? - What is a gamete? - Which type of cell division produces gametes? Diamond (Challenge) - Why do children inherit characteristics from both parents? Teacher Uses Responses To - Assess understanding of inheritance. - Identify misconceptions about genes and gametes. - Link meiosis to inheritance.			
Hook / Intro (5 mins)	Introduce Key Idea “Why do some children have characteristics that neither parent appears to show?” Suggested Strategy Show simple examples of inherited characteristics: - Eye colour - Attached/free earlobes - Tongue rolling Ask: - Why do siblings sometimes look different from one another? - Can parents pass on characteristics they do not show themselves? Pedagogical Rationale Creates curiosity about inheritance patterns and			

	introduces dominant and recessive alleles.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Key Genetic Terms Genotype The combination of alleles an organism possesses. Example: BB Bb bb Phenotype The observable characteristic produced. Example: - Brown eyes - Blue eyes Dominant Allele An allele expressed when only one copy is present. Represented by: B Recessive Allele Only expressed when two copies are present. Represented by: b Homozygous Two identical alleles. Examples: - BB - bb Heterozygous Two different alleles. Example: - Bb Sex Determination Introduce: Females: XX Males: XY The sperm cell determines biological sex because it can carry: X or Y Punnett Squares			

	Introduce a simple monohybrid cross: Parents: Bb X Bb Model completion: Bb Bb BB Bb Bb bb Interpret results: • 3 dominant phenotypes • 1 recessive phenotype Key Idea Punnett squares predict probabilities, not guarantees. Teacher Modelling (EEF 3) Model: 1. Identify parental genotypes. 2. Determine gametes. 3. Complete Punnett square. 4. Calculate genotype outcomes. 5. Determine phenotype outcomes. Explicitly explain: “The Punnett square predicts the probability of inheritance, not exactly what will happen.” Check for Understanding (Hinge Point) • What is a genotype? • What is a phenotype? • What does heterozygous mean? • What is a dominant allele? • Which parent determines biological sex? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported Punnett square construction. Pupils • Match key terms to definitions.			

	- Identify genotypes and phenotypes. - Complete simple Punnett squares. - Interpret outcomes. Teacher Role - Model first examples. - Reinforce terminology. - Check accuracy before independent work.			
Main Task (20 mins)	Core Task Pupils: - Define genetic terminology. - Complete Punnett squares. - Predict inheritance outcomes. - Interpret genotype and phenotype ratios. Suggested Activities - Vocabulary card sort - Genetic diagram completion - Monohybrid crosses - Sex determination Punnett square Teacher Flexibility Teachers select format based on class need: - Guided worksheet - Whiteboard modelling - Genetic card sort - GCSE-style application questions Success Criteria - Correctly define key genetic terms. - Complete Punnett squares accurately. - Interpret genotype and phenotype outcomes. - Explain inheritance using scientific vocabulary. - Use probabilities appropriately. Adaptation Prompts If pupils struggle - Provide genotype templates. - Use colour-coded alleles. - Scaffold Punnett square construction. If secure - Complete more complex crosses. - Interpret family inheritance scenarios. - Explain sex determination in humans.			

Support / Diamond (challenge)	Support • Vocabulary mat. • Punnett square framework. • Worked examples. Example sentence starters: “The genotype of this individual is _____.” “The phenotype produced is _____.” Diamond (Challenge) • Analyse multi-step inheritance problems. • Explain why siblings can inherit different combinations of alleles. • Evaluate the strengths and limitations of Punnett squares as predictive tools.			
Common misconceptions	• Genotype and phenotype mean the same thing. • Dominant alleles are always more common. • A dominant allele is stronger than a recessive allele. • Punnett squares show exactly what will happen. • Mothers determine the biological sex of offspring.			
Assessment (5 mins)	Formative and Summary Quick Check Options • Define genotype. • Define phenotype. • Complete a Punnett square. • Identify dominant and recessive alleles. Diagnostic Focus Can pupils: • Use genetic terminology accurately? • Construct Punnett squares correctly? • Interpret inheritance outcomes? • Explain sex determination?			
Exit ticket (5 mins)	Purpose Inform planning for B6.05 Embryo Screening and Family Trees			

	Example Questions • What is a genotype? • What is the difference between homozygous and heterozygous? • Which parent determines biological sex? Teacher uses responses to identify misconceptions before moving on to family trees and embryo screening.			
Adaptive teaching	• Retrieval links meiosis to inheritance. • Hinge questions identify misconceptions about genetics. • Worked examples reduce cognitive load. • Vocabulary is explicitly taught and revisited. • Challenge develops application and probability reasoning. • Exit ticket informs progression to genetic screening.			
British Values	Democracy - Students use evidence and probability to justify genetic predictions and inheritance outcomes. Individual Liberty - Students independently apply scientific knowledge to solve genetic problems and interpret inheritance patterns.			
Teacher Notes for MTP adaptations				

B6.05 Embryo Screening and Family Trees		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Describe what embryo screening is and what it is used for - Interpret simple family trees to identify patterns of inherited conditions - Discuss the economic, social and ethical issues associated with embryo screening	Analyse family tree information to identify patterns of inheritance. Apply knowledge of genetic inheritance to explain the purpose of embryo screening. Evaluate the scientific, ethical and social implications of embryo screening using evidence.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific developments influence modern medicine. WS 3.5 (Interpret Data) Interpret information from family trees and pedigree diagrams. WS 3.6 (Explain using Evidence) Explain decisions about embryo screening using genetic evidence. WS 3.7 (Evaluation) Evaluate different viewpoints using scientific evidence. WS 4.1 (Scientific Vocabulary) Use terms such as embryo screening, carrier, inherited condition, pedigree and risk accurately. Maths Skills 1c (Probability) Consider likelihood of inherited conditions. 2c (Patterns and Relationships) Identify inheritance patterns within family trees. 4a (Interpretation) Interpret pedigree diagrams and genetic information.	EEF 4 (Memory): Retrieve prior learning about Punnett squares, genotype and phenotype. EEF 3 (Modelling): Model how to read family trees and interpret inheritance patterns. EEF 6 (Language): Explicit teaching of ethical and genetic vocabulary. EEF 7 (Feedback): Feedback used to improve evaluation and scientific reasoning.
Do Now (5 mins)	Purpose Retrieve prior learning from genetic crosses and inheritance. Suggested Structure (teacher adapts) - What is a genotype? - What is a phenotype? - What is a dominant allele? Diamond (Challenge) - Why might some families want to know the genetic conditions carried by their children before birth? Teacher Uses Responses To - Assess understanding of inheritance. - Identify misconceptions about genetic disorders. - Prepare pupils for family-tree analysis.			
Hook / Intro (5 mins)	Introduce Key Idea “Should scientists be able to identify inherited disorders before a baby is born?” Suggested Strategy Present a scenario: A family has a history of a serious inherited disorder. Doctors offer embryo screening during IVF treatment. Ask: - Why might the family want screening? - What information could screening provide? - Are there any concerns about using this technology? Pedagogical Rationale Introduces a real-world application of genetics and creates an opportunity for evidence-based discussion.			

Direct Teaching: Cell Structure (10 – 15 mins)	Content: Embryo Screening Introduce: Embryo Screening • A process used during IVF. • Embryos are tested for particular inherited disorders before implantation. Why Embryo Screening May Be Used • Reduce the chance of serious inherited disorders. • Help families make informed decisions. • Increase understanding of inherited conditions. Examples may include: • Cystic fibrosis • Huntington's disease Key Idea Embryo screening does not change the genetic information of an embryo. It provides information about the genes already present. Content: Family Trees (Pedigree Diagrams) Introduce: Family Tree / Pedigree Diagram • A diagram showing how characteristics or conditions are inherited through generations. Pupils should be able to: • Follow inheritance through generations. • Identify affected and unaffected family members. • Recognise inheritance patterns. Teacher Modelling (EEF 3) Model a simple pedigree diagram. Explain: • Squares = males • Circles = females • Shaded symbols = affected individuals Model questions: • Which individuals have the condition? • How many generations are shown?			
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	- Does the condition appear in every generation? Economic, Social and Ethical Issues Introduce balanced discussion: Possible Benefits - Reduced risk of inherited disease - Improved health outcomes - Informed family choices Possible Concerns - Cost of treatment - Ethical questions about embryo selection - Different viewpoints within society Check for Understanding (Hinge Point) - What is embryo screening? - Why might a family choose embryo screening? - What information can be gained from a pedigree diagram? - Give one benefit and one concern associated with embryo screening. Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported pedigree interpretation. Pupils - Identify patterns in simple family trees. - Match terms to definitions. - Sort statements into benefits and concerns. Teacher Role - Model first examples. - Reinforce scientific vocabulary. - Support interpretation of diagrams.			
Main Task (20 mins)	Core Task Pupils: - Interpret family tree diagrams. - Identify inheritance patterns. - Explain the purpose of embryo screening. - Evaluate different viewpoints about embryo screening.			

	Suggested Activities • Pedigree diagram interpretation • Ethical discussion cards • Advantages/disadvantages table • GCSE-style 6-mark evaluation question Teacher Flexibility Teachers select format based on class need: • Structured family-tree worksheet • Discussion-based lesson • Scenario cards • Extended evaluation task Success Criteria • Describe embryo screening accurately. • Interpret simple pedigree diagrams. • Explain why embryo screening may be used. • Evaluate benefits and concerns using evidence. • Use scientific vocabulary correctly. Adaptation Prompts If pupils struggle • Provide labelled pedigree diagrams. • Use guided questioning. • Supply key vocabulary definitions. If secure • Analyse more complex family trees. • Link inheritance patterns to genetic disorders. • Construct balanced evaluations using evidence.			
Support / Diamond (challenge)	Support / Diamond (Challenge) Support • Family tree key. • Vocabulary mat. • Structured evaluation scaffold. Example sentence starters: “Embryo screening is used to _____.” “One advantage is _____.” “One concern is _____.”			

	Diamond (Challenge) - Analyse inheritance patterns using family trees. - Explain how embryo screening may influence healthcare decisions. - Evaluate ethical arguments using scientific evidence.			
Common misconceptions	- Embryo screening alters an embryo's genes. - Embryo screening guarantees a healthy child. - Family trees only show physical characteristics. - Genetic disorders are always inherited from one parent. - Everyone will agree on whether embryo screening should be used.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define embryo screening. - Identify a pattern from a family tree. - Give one advantage of embryo screening. - Give one concern about embryo screening. Diagnostic Focus Can pupils: - Interpret pedigree diagrams? - Explain the purpose of embryo screening? - Discuss ethical issues using evidence? - Use accurate scientific vocabulary?			
Exit ticket (5 mins)	Purpose Inform planning for B6.06 Variation Example Questions - What is embryo screening? - What information can a pedigree diagram provide? - Give one reason why a family might choose embryo screening. Teacher uses responses to identify misconceptions before introducing variation.			
Adaptive teaching	- Retrieval strengthens understanding of inheritance and Punnett squares. - Hinge questions identify misconceptions about			

	genetic conditions. • Modelled pedigree interpretation reduces cognitive load. • Structured discussion supports evaluation skills. • Challenge develops evidence-based decision making. • Exit ticket informs progression to variation.			
British Values	Tolerance - Students recognise that people may hold different ethical viewpoints about embryo screening and genetic technologies. Democracy - Students discuss and justify viewpoints using evidence rather than opinion alone. Mutual Respect - Students engage respectfully with sensitive issues and alternative perspectives.			
Teacher Notes for MTP adaptations				

B6.06 Variation		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	• Classify characteristics as being due to genetic, environmental or a combination of these causes • Give examples of continuous and discontinuous variation	Analyse data to determine whether variation is continuous or discontinuous. Apply knowledge of genetic	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand that variation	EEF 4 (Memory): Retrieve prior learning about inheritance, genes and reproduction.

	Select appropriate ways to present information about variation using tables and charts	and environmental factors to explain variation in unfamiliar examples.	occurs within populations and contributes to biodiversity.	EEF 3 (Modelling): Model classification of variation and interpretation of graphical data.
Do Now (5 mins)	Purpose Retrieve prior learning about inheritance and genetic diagrams. Suggested Structure (teacher adapts) - What is a gene? - What is inherited from parents? - What is a phenotype? Diamond (Challenge) - Why are individuals within the same species not all identical? Teacher Uses Responses To - Assess understanding of inheritance. - Identify misconceptions about genetic variation. - Prepare pupils for studying differences between individuals.	Evaluate the relative importance of genetic and environmental factors in producing variation.	WS 3.5 (Interpret Data) Analyse patterns in biological data. WS 3.6 (Explain using Evidence) Use evidence to explain the causes of variation. WS 3.7 (Evaluation) Evaluate explanations for variation. WS 4.1 (Scientific Vocabulary) Use terms such as variation, continuous, discontinuous, genetic and environmental accurately.	EEF 6 (Language): Explicit teaching of key terminology associated with variation. EEF 7 (Feedback): Feedback used to improve explanations and interpretation of data.
Hook / Intro (5 mins)	Introduce Key Idea “Why do brothers and sisters often look similar but are not identical?” Suggested Strategy Display examples of variation: - Human heights - Eye colour - Blood group - Hand span Ask: - Which characteristics show many possible values? - Which characteristics fit into clear categories? - What causes these differences? Pedagogical Rationale Introduces variation through familiar examples and begins discussion of genetic and environmental influences.		Maths Skills 1c (Classification) Categorise examples of variation. 2c (Patterns and Relationships) Identify trends and patterns in data. 4a (Interpretation) Interpret tables, charts and graphs showing variation.	
Direct Teaching: Cell Structure (10	Content: Variation Introduce:			

– 15 mins)

Variation

- The differences between individuals of the same species.

Causes of Variation

Genetic Variation

Caused by:

- Inherited genes from parents.

Examples:

- Eye colour
- Blood group

Environmental Variation

Caused by:

- Conditions experienced during life.

Examples:

- Language spoken
- Suntan

Combination of Genetic and Environmental Factors

Examples:

- Height
- Body mass
- Intelligence

Continuous Variation

Characteristics that can take any value within a range.

Examples:

- Height
- Hand span
- Mass

Usually displayed using:

- Histograms

Discontinuous Variation

Characteristics that fit into categories.

Examples:

- Blood group
- Ability to roll the tongue

Usually displayed using:

- Bar charts

	Key Idea Variation can be caused by: • Genes • Environment • Both Scientists use data presentation to identify patterns in variation. Teacher Modelling (EEF 3) Model classification: <table><tr><th>Characteristic</th><th>Genetic</th><th>Environmental</th><th>Both</th></tr><tr><td>Eye colour</td><td>✓</td><td></td><td></td></tr><tr><td>Language</td><td></td><td>✓</td><td></td></tr><tr><td>Height</td><td></td><td></td><td>✓</td></tr></table> Model graph selection: • Histogram → Continuous variation • Bar chart → Discontinuous variation Check for Understanding (Hinge Point) • What is variation? • What is continuous variation? • What is discontinuous variation? • Is height caused only by genes? • Which graph would you use for blood groups? Mini whiteboards / cold calling	Characteristic	Genetic	Environmental	Both	Eye colour	✓			Language		✓		Height			✓			
Characteristic	Genetic	Environmental	Both																	
Eye colour	✓																			
Language		✓																		
Height			✓																	
Guided Practice (10 mins)	Task Type Supported classification and graph selection. Pupils • Sort characteristics into genetic, environmental or both. • Classify variation as continuous or discontinuous. • Match datasets to appropriate graphs. Teacher Role • Model first examples. • Reinforce scientific vocabulary. • Correct misconceptions immediately.																			

Main Task (20 mins)	Core Task Pupils: • Classify examples of variation. • Compare continuous and discontinuous variation. • Interpret data sets. • Select suitable methods of data presentation. • Explain causes of variation using evidence. Suggested Activities • Card sort activity • Data interpretation worksheet • Graph selection task • GCSE-style application questions Teacher Flexibility Teachers select format based on class need: • Sorting tasks • Table completion • Graph interpretation • Structured written explanations Success Criteria • Define variation accurately. • Classify causes of variation correctly. • Distinguish between continuous and discontinuous variation. • Select appropriate data presentation methods. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Provide classification tables. • Use visual examples. • Scaffold graph selection. If secure • Interpret unfamiliar data sets. • Explain complex examples involving multiple causes. • Evaluate the importance of genes versus environment.			
Support / Diamond (challenge)	Support • Variation classification sheet. • Example graphs.			

	- Vocabulary mat. Example sentence starters: “This characteristic is genetic because _____. ” “This is continuous variation because _____. ” Diamond (Challenge) - Analyse a dataset and justify the most appropriate presentation method. - Evaluate whether genes or environment have the greater influence on a particular characteristic. - Explain how variation contributes to evolution.			
Common misconceptions	- All variation is inherited. - Environmental factors have no effect on characteristics. - Continuous and discontinuous variation are the same. - Height is determined only by genes. - Variation only occurs between different species.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define variation. - Identify an example of continuous variation. - Identify an example of discontinuous variation. - Classify a characteristic as genetic, environmental or both. Diagnostic Focus Can pupils: - Explain the causes of variation? - Distinguish between continuous and discontinuous variation? - Select appropriate graphs? - Use scientific terminology accurately?			
Exit ticket (5 mins)	Purpose Inform planning for B6.07 Selective Breeding Example Questions What is variation?			

	• Name one example of continuous variation. • Name one characteristic influenced by both genes and environment. Teacher uses responses to identify misconceptions before introducing selective breeding.			
Adaptive teaching	• Retrieval strengthens understanding of inheritance and genetics. • Hinge questions identify misconceptions about variation. • Classification activities reduce cognitive load. • Data interpretation develops analytical skills. • Challenge develops evaluation and application. • Exit ticket informs progression to selective breeding.			
British Values	Democracy - Students discuss and justify explanations for differences between individuals using scientific evidence. Individual Liberty - Students independently evaluate the effects of genes and environment on variation.			
Teacher Notes for MTP adaptations				

B6.07 Selective Breeding		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Explain why humans selectively breed plants and animals - Describe the process of selective breeding and give examples - Explain the benefits and risks of selective breeding in plants and animals	Analyse how selective breeding changes the characteristics of populations over time. Apply knowledge of inheritance to explain why selective breeding can increase desirable characteristics. Evaluate the benefits and risks of selective breeding in agriculture and food production.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how humans use scientific knowledge to influence inheritance. WS 3.5 (Interpret Data) Analyse evidence about inherited characteristics. WS 3.6 (Explain using Evidence) Explain outcomes of selective breeding using genetics. WS 3.7 (Evaluation) Evaluate advantages and disadvantages using scientific evidence. WS 4.1 (Scientific Vocabulary) Use terms such as selective breeding, inherited, characteristic, offspring and population accurately. Maths Skills 1c (Comparisons) Compare characteristics of parent organisms and offspring. 2c (Patterns and Relationships) Identify patterns in inherited traits over generations.	EEF 4 (Memory): Retrieve prior learning about variation, inheritance and reproduction. EEF 3 (Modelling): Model how selective breeding changes characteristics over several generations. EEF 6 (Language): Explicit teaching of scientific vocabulary linked to inheritance and breeding. EEF 7 (Feedback): Feedback used to improve explanations and evaluations.
Do Now (5 mins)	Purpose Retrieve prior learning about inheritance and variation. Suggested Structure (teacher adapts) - What is variation? - Which characteristics can be inherited? - Give one example of a genetic characteristic. Diamond (Challenge) - Why might farmers want animals or plants with particular characteristics? Teacher Uses Responses To - Assess understanding of inheritance. - Identify misconceptions about variation. - Establish links between inherited characteristics and breeding.			
Hook / Intro (5 mins)	Introduce Key Idea “Why are modern farm animals often very different from their wild ancestors?” Suggested Strategy Show images of: - Wild wolf vs domestic dog breeds - Wild cabbage vs broccoli/cauliflower - Traditional cattle vs modern dairy cattle Ask: - Why do these organisms look different? - Did these changes happen naturally? - Could humans have influenced these characteristics? Pedagogical Rationale Introduces selective breeding through familiar examples and links it to inheritance.			
Direct Teaching:	Content: Selective Breeding			

Cell Structure (10 – 15 mins)	Introduce: Selective Breeding - A process in which humans select organisms with desirable characteristics and breed them together. The Process - Select parents with desirable traits. - Breed the selected organisms. - Choose offspring with the desired characteristics. - Repeat over many generations. Examples Plants - Disease-resistant crops - Larger fruits - Higher crop yields Animals - Dairy cattle producing more milk - Sheep producing more wool - Dogs bred for specific characteristics Key Idea Selective breeding increases the frequency of desirable inherited characteristics within a population. Benefits - Greater food production - Improved crop quality - Increased disease resistance - Desirable animal characteristics Risks - Reduced genetic variation - Increased likelihood of inherited health problems - Greater vulnerability to disease and environmental change Teacher Modelling (EEF 3) Model a breeding programme: Large yield plant + Large yield plant → Offspring with large yield → Select and breed again			
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	Model explanation: “The desirable characteristic becomes more common because plants with that characteristic are repeatedly chosen to breed.” Check for Understanding (Hinge Point) • What is selective breeding? • Why are particular parents chosen? • Give one benefit of selective breeding. • Give one risk of selective breeding. Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported sequencing and explanation. Pupils • Sequence stages of selective breeding. • Match examples to benefits. • Match risks to explanations. Teacher Role • Model first examples. • Reinforce inheritance vocabulary. • Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Describe how selective breeding works. • Explain why it is used. • Compare benefits and risks. • Use inheritance knowledge to explain outcomes. Suggested Activities • Flow-chart completion • Benefits vs risks comparison table • Agriculture case studies • GCSE-style evaluation question Teacher Flexibility Teachers select format based on class need: • Card sort			

	• Structured worksheet • Comparison table • Extended written evaluation Success Criteria • Describe the process of selective breeding. • Explain why it is used. • Identify benefits and risks. • Link outcomes to inheritance. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Provide flow diagrams. • Use scaffolded explanations. • Highlight inheritance links. If secure • Explain long-term consequences of reduced genetic variation. • Compare selective breeding with natural selection. • Evaluate breeding strategies using evidence.			
Support / Diamond (challenge)	Support • Selective breeding flow chart. • Vocabulary mat. • Comparison scaffold. Example sentence starters: “Selective breeding is used because _____.” “One benefit is _____.” “One risk is _____.” Diamond (Challenge) • Evaluate whether the benefits outweigh the risks. • Explain how selective breeding affects genetic variation. • Compare selective breeding in plants and animals.			
Common	• Selective breeding and genetic engineering are			

misconceptions	the same process. • Selectively bred organisms are not natural. • Selective breeding creates new genes. • Selective breeding only occurs in animals. • More selective breeding always produces better results.			
Assessment (5 mins)	Formative and Summary Quick Check Options • Define selective breeding. • Describe one stage of the process. • Give one advantage and one disadvantage. • Explain why inheritance is important in selective breeding. Diagnostic Focus Can pupils: • Describe the process accurately? • Explain why it works? • Evaluate benefits and risks? • Use scientific vocabulary correctly?			
Exit ticket (5 mins)	Purpose Inform planning for B6.08 Genetic Engineering Example Questions • What is selective breeding? • Why do humans use selective breeding? • State one risk of selective breeding. Teacher uses responses to identify misconceptions before introducing genetic engineering.			
Adaptive teaching	• Retrieval strengthens understanding of inheritance and variation. • Hinge questions identify misconceptions about breeding. • Flow diagrams reduce cognitive load. • Vocabulary is explicitly taught and revisited. • Challenge develops evaluation and application skills. • Exit ticket informs progression to genetic engineering.			
British Values	Democracy - Students evaluate evidence and justify conclusions about the use of selective breeding. Tolerance - Students consider differing viewpoints about the benefits and risks of selective breeding.			

Teacher Notes for MTP adaptations	

B6.08 Genetic Engineering		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Define the term genetic engineering - Explain the advantages and disadvantages of genetic engineering - Evaluate the use of genetic engineering	Analyse how genetic engineering can be used to solve biological and medical problems.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how advances in genetics have changed modern biology and medicine. WS 3.5 (Interpret Data) Analyse information and case studies relating to genetic engineering. WS 3.6 (Explain using Evidence) Explain the process and applications of genetic engineering. WS 3.7 (Evaluation) Evaluate benefits, risks and ethical considerations using evidence. WS 4.1 (Scientific Vocabulary) Use terms such as genetic engineering, gene, DNA, genome and modification accurately. Maths Skills 1c (Comparisons) Compare advantages and disadvantages of different applications. 2c (Patterns and Relationships) Link genetic modifications to changes in organism characteristics.	EEF 4 (Memory): Retrieve prior learning about DNA, genes and inheritance. EEF 3 (Modelling): Model the process of genetic engineering using clear diagrams and examples. EEF 6 (Language): Explicit teaching of scientific and ethical vocabulary. EEF 7 (Feedback): Feedback used to improve evaluation and evidence-based judgement.
Do Now (5 mins)	Purpose Retrieve prior learning about DNA, genes, inheritance and selective breeding. Suggested Structure (teacher adapts) - What is a gene? - What is DNA? - What is selective breeding? Diamond (Challenge) - Could a scientist directly change an organism's genes rather than breeding organisms together? Teacher Uses Responses To - Assess understanding of inheritance. - Identify misconceptions about genes and DNA. - Prepare pupils for genetic engineering.	Apply knowledge of genes and DNA to explain how genetic engineering changes the characteristics of organisms. Evaluate the scientific, ethical and environmental implications of genetic engineering using evidence.		
Hook / Intro (5 mins)	Introduce Key Idea "What if scientists could take a useful gene from one organism and place it into another?" Suggested Strategy Display examples of: - Bacteria producing human insulin. - Golden Rice containing increased Vitamin A. - Insect-resistant crop plants. Ask: - How might scientists make these changes? - Why might these changes be useful? - Could there be any risks? Pedagogical Rationale Introduces real-world applications before teaching the science, creating relevance and engagement.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Genetic Engineering Introduce: Genetic Engineering			

	• The process of transferring a gene from one organism to another organism. Simplified Process 1. Identify a useful gene. 2. Remove the gene from the donor organism. 3. Insert the gene into another organism. 4. The recipient organism develops the new characteristic. Key Idea Changing genes changes the proteins produced by an organism. This can alter the organism's characteristics. Example 1: Human Insulin Production Scientists insert the human insulin gene into bacteria. The bacteria then: • Produce insulin. • Allow insulin to be manufactured on a large scale. Example 2: Crop Plants Genes may be transferred to create crops that are: • More resistant to disease. • More resistant to insect damage. • More nutritious. Advantages of Genetic Engineering • Increased food production. • Improved nutritional value. • Medical benefits. • Reduced crop losses. Disadvantages of Genetic Engineering • Ethical concerns. • Potential environmental impacts. • Uncertainty about long-term effects. • Concerns about biodiversity. Teacher Modelling (EEF 3) Model: Useful gene → Transfer → Recipient organism → New			
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	characteristic Example: Human insulin gene → Bacterial cell → Insulin production Model balanced evaluation: “Genetic engineering can improve healthcare and food production, but scientists also consider possible environmental and ethical concerns.” Check for Understanding (Hinge Point) • What is genetic engineering? • What is transferred during genetic engineering? • Give one benefit of genetic engineering. • Give one concern about genetic engineering. Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported explanation and evaluation. Pupils • Match applications to benefits. • Sort statements into advantages and disadvantages. • Explain how a gene transfer leads to a new characteristic. Teacher Role • Model first examples. • Reinforce scientific vocabulary. • Challenge unsupported opinions.			
Main Task (20 mins)	Core Task Pupils: • Define genetic engineering. • Describe examples of genetic engineering. • Explain advantages and disadvantages. • Evaluate the use of genetic engineering using evidence. Suggested Activities • Advantages/disadvantages comparison table. • Case-study analysis. • Structured evaluation task. • GCSE-style 6-mark question.			

	Teacher Flexibility Teachers select format based on class need: • Information carousel. • Card sort activity. • Structured worksheet. • Extended writing task. Success Criteria • Define genetic engineering accurately. • Explain how genes can be transferred. • Describe practical applications. • Explain advantages and disadvantages. • Use evidence to support evaluations. Adaptation Prompts If pupils struggle • Provide key-word definitions. • Use scaffolded comparison tables. • Provide sentence stems. If secure • Compare genetic engineering and selective breeding. • Evaluate multiple viewpoints. • Apply knowledge to unfamiliar examples.			
Support / Diamond (challenge)	Support • Genetic engineering fact sheet. • Vocabulary mat. • Evaluation scaffold. Example sentence starters: “One advantage of genetic engineering is _____.” “One concern is _____.” “Genetic engineering differs from selective breeding because _____.” Diamond (Challenge) • Evaluate whether genetic engineering should be widely used in agriculture. • Compare genetic engineering and selective breeding.			

	Analyse ethical arguments using scientific evidence.			
Common misconceptions	- Genetic engineering and selective breeding are the same process. - Scientists can transfer characteristics without transferring genes. - Genetic engineering always produces positive outcomes. - Genetically modified organisms are automatically harmful. - Scientists can predict every consequence of genetic modification.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define genetic engineering. - Describe one application. - State one advantage and one disadvantage. - Compare genetic engineering and selective breeding. Diagnostic Focus Can pupils: - Explain how genetic engineering works? - Identify useful applications? - Evaluate advantages and disadvantages? - Use scientific vocabulary accurately?			
Exit ticket (5 mins)	Purpose Inform planning for B6.09 Evolution Example Questions - What is genetic engineering? - Give one medical application of genetic engineering. - State one concern about genetic engineering. Teacher uses responses to identify misconceptions before moving into evolution.			
Adaptive teaching	- Retrieval strengthens links between genes, DNA and inheritance. - Hinge questions identify misconceptions about genetic modification. - Use of real-world examples supports understanding.			

	• Vocabulary is explicitly taught and revisited. • Challenge develops evaluation and evidence-based judgement. • Exit ticket informs progression to evolution.			
British Values	Tolerance - Students recognise that people may hold different ethical viewpoints regarding genetic engineering. Democracy - Students evaluate scientific evidence and discuss different viewpoints before reaching conclusions. Individual Liberty - Students make informed judgements about genetic technologies using evidence rather than opinion.			
Teacher Notes for MTP adaptations				

B6.09 Evolution		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Describe Darwin's theory of evolution by natural selection - Describe the main stages of natural selection - Define the term mutation - Explain why mutation may lead to more rapid change in a species	Analyse how variation and natural selection can lead to evolutionary change over time. Apply knowledge of mutation and selection to explain how populations adapt to changing environments. Evaluate the evidence supporting Darwin's theory of evolution by natural selection.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific theories develop through evidence and observation. WS 3.5 (Interpret Data) Interpret evidence relating to variation, adaptation and evolution. WS 3.6 (Explain using Evidence) Explain evolutionary change using scientific reasoning. WS 3.7 (Evaluation) Evaluate scientific explanations using evidence. WS 4.1 (Scientific Vocabulary) Use terms such as evolution, adaptation, mutation, variation and natural selection accurately. Maths Skills 1c (Comparisons) Compare characteristics of organisms within populations. 2c (Patterns and Relationships) Identify links between variation, survival and reproduction.	EEF 4 (Memory): Retrieve prior learning about variation, inheritance and selective breeding. EEF 3 (Modelling): Model the stages of natural selection using familiar examples. EEF 6 (Language): Explicit teaching of specialist evolutionary vocabulary. EEF 7 (Feedback): Feedback used to improve explanations of adaptation and evolution.
Do Now (5 mins)	Purpose Retrieve prior learning about variation, inheritance and selective breeding. Suggested Structure (teacher adapts) - What is variation? - What is an inherited characteristic? - What is selective breeding? Diamond (Challenge) - Why might some individuals survive better than others in the same environment? Teacher Uses Responses To - Assess understanding of variation. - Identify misconceptions about evolution. - Establish links between variation and survival.			
Hook / Intro (5 mins)	Purpose Retrieve prior learning about variation, inheritance and selective breeding. Suggested Structure (teacher adapts) - What is variation? - What is an inherited characteristic? - What is selective breeding? Diamond (Challenge) - Why might some individuals survive better than others in the same environment? Teacher Uses Responses To - Assess understanding of variation. - Identify misconceptions about evolution. - Establish links between variation and survival.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Darwin's Theory of Evolution Introduce: Evolution			

	• The gradual change in the inherited characteristics of a population over time. Charles Darwin Explain: Darwin proposed that evolution occurs through: Natural Selection Stages of Natural Selection 1. Variation Individuals within a species show variation. Examples: • Different beak sizes • Different fur thicknesses • Different colours 2. Competition More offspring are produced than can survive. Organisms compete for: • Food • Space • Mates • Shelter 3. Survival Individuals with advantageous characteristics are more likely to survive. 4. Reproduction Successful organisms reproduce and pass on their genes. 5. Evolution Over Time Beneficial characteristics become more common within the population. Mutation Introduce: Mutation • A random change in DNA. Explain: Mutations: • Create new alleles. • Increase variation. • May be beneficial, harmful or have no effect.			
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	Key Idea Mutation provides new variation. Natural selection acts on variation. Together they drive evolution. Teacher Modelling (EEF 3) Model a simple example: Cold Environment Variation: • Some rabbits have thicker fur. Outcome: • Rabbits with thicker fur survive better. Result: • More thick-furred rabbits in future generations. Model: Variation → Competition → Survival → Reproduction → Evolution Check for Understanding (Hinge Point) • What is evolution? • What is natural selection? • What is a mutation? • Why is variation important? • What happens to beneficial characteristics over time? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported sequencing and explanation. Pupils • Sequence the stages of natural selection. • Match terms to definitions. • Explain simple examples of adaptation. Teacher Role • Model first examples. • Reinforce scientific vocabulary. • Correct misconceptions immediately.			

Main Task (20 mins)	Core Task Pupils: • Describe Darwin's theory of evolution. • Explain the steps of natural selection. • Explain the role of mutation. • Apply understanding to biological examples. Suggested Activities • Natural selection flow chart. • Darwin's finches case study. • Peppered moths analysis. • GCSE-style application questions. Teacher Flexibility Teachers select format based on class need: • Sequencing cards. • Structured worksheet. • Diagram annotation. • Extended written explanation. Success Criteria • Define evolution accurately. • Describe natural selection. • Define mutation. • Explain the role of variation. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Use flow diagrams. • Provide sentence starters. • Use worked examples. If secure • Analyse unfamiliar examples. • Explain rapid evolutionary change due to mutation. • Evaluate evidence for Darwin's theory.			
Support / Diamond (challenge)	Support • Natural selection flow chart. • Vocabulary mat. • Sequencing scaffold. Example sentence starters:			

	“Natural selection occurs because _____.” “A mutation may result in _____.” “Evolution happens when _____.” Diamond (Challenge) • Explain why mutation can increase the rate of evolutionary change. • Evaluate how strong the evidence for natural selection is. • Analyse how environmental change can alter selection pressures.			
Common misconceptions	• Individual organisms evolve during their lifetime. • Organisms evolve because they need to. • Mutations are always harmful. • The strongest organisms always survive. • Evolution happens quickly within a few generations.			
Assessment (5 mins)	Formative and Summary Quick Check Options • Define evolution. • Define mutation. • Explain natural selection. • Explain why variation is important. Diagnostic Focus Can pupils: • Explain Darwin’s theory accurately? • Describe natural selection? • Explain the role of mutation? • Use scientific vocabulary correctly?			
Exit ticket (5 mins)	Purpose Inform planning for B6.10 Fossils Example Questions • What is natural selection? • What is a mutation? • Why is variation important in evolution? Teacher uses responses to identify misconceptions before studying fossil evidence.			

Adaptive teaching	• Retrieval strengthens understanding of inheritance and variation. • Hinge questions identify misconceptions about evolution. • Visual models reduce cognitive load. • Vocabulary is explicitly taught and revisited. • Challenge develops evaluation and application. • Exit ticket informs progression to fossils.			
British Values	Tolerance - Students understand that scientific theories develop and change when new evidence becomes available. Individual Liberty - Students independently evaluate evidence supporting evolutionary theory.			
Teacher Notes for MTP adaptations				

B6.10 Fossils		HPA Challenge	Skills	EEF Recommendations
Leaning Objectives	- Define the term fossil - Describe how fossils may be formed - Explain why scientists cannot be certain how life began on Earth - Explain how fossils provide evidence for evolution	Analyse how fossil evidence supports evolutionary theory. Apply knowledge of fossil formation to explain why the fossil record is incomplete.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific theories are supported by evidence gathered over time. WS 3.5 (Interpret Data) Interpret evidence from fossil records and evolutionary timelines. WS 3.6 (Explain using Evidence) Explain how fossils provide evidence for evolution. WS 3.7 (Evaluation) Evaluate the reliability and limitations of fossil evidence. WS 4.1 (Scientific Vocabulary) Use terms such as fossil, evolution, extinction, sediment and preservation accurately. Maths Skills 1c (Comparisons) Compare fossil evidence from different time periods. 2c (Patterns and Relationships) Identify trends and changes in organisms over time.	EEF 4 (Memory): Retrieve prior learning about evolution, variation and natural selection. EEF 3 (Modelling): Model how fossil evidence supports evolutionary explanations. EEF 6 (Language): Explicit teaching of specialist vocabulary associated with fossils and evolution. EEF 7 (Feedback): Feedback used to improve evidence-based explanations and evaluations.
Do Now (5 mins)	Purpose Retrieve prior learning about evolution and natural selection. Suggested Structure (teacher adapts) - What is evolution? - What is natural selection? - What is a mutation? Diamond (Challenge) - How do scientists know that organisms have changed over millions of years? Teacher Uses Responses To - Assess understanding of evolutionary theory. - Identify misconceptions about evidence for evolution. - Prepare students to use fossils as evidence.	Evaluate the strengths and limitations of fossil evidence when explaining the history of life on Earth.		
Hook / Intro (5 mins)	Introduce Key Idea “How can scientists study organisms that lived millions of years ago?” Suggested Strategy Display: - Dinosaur fossil - Ammonite fossil - Fossil skeleton of an extinct mammal Ask: - What information can fossils provide? - How are fossils preserved for millions of years? - Why are fossils important to scientists? Pedagogical Rationale Creates curiosity and highlights fossils as evidence for understanding the past.			
Direct Teaching:	Content: Fossils			

Cell Structure (10 – 15 mins)	Introduce: Fossil - The preserved remains or traces of an organism from the past. How Fossils Form Method 1: Gradual Replacement by Minerals - Organism dies. - Buried by sediment. - Soft tissues decay. - Minerals replace hard parts. - Fossil forms over millions of years. Method 2: Casts and Impressions - Organism leaves an impression in sediment. - Sediment hardens to form fossil evidence. Method 3: Preservation in Amber, Ice or Peat - Organisms are preserved directly. - Useful for examining fine details. Why the Fossil Record is Incomplete Explain: - Many organisms decay before fossilisation. - Soft-bodied organisms rarely fossilise. - Geological processes may destroy fossils. - Fossilisation is a rare event. Fossils and Evolution Introduce: Fossils provide evidence that: - Organisms have changed over time. - Extinct species once existed. - New species have evolved from earlier forms. How Fossils Support Darwin's Theory Evidence shows: - Gradual changes in organisms. - Transitional forms between groups. - Patterns consistent with evolution by natural selection. Origins of Life Explain: Scientists cannot be certain how life began because:			
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	• Very little direct evidence remains. • The earliest organisms left few traces. • Events occurred billions of years ago. Key Idea Fossils provide important but incomplete evidence about the history of life on Earth. Teacher Modelling (EEF 3) Model explanation: “Fossils show that organisms living today are different from organisms that lived millions of years ago. This supports the theory that species change over time through evolution.” Model evaluation: Strength • Direct evidence of past organisms. Limitation • Fossil record is incomplete. Check for Understanding (Hinge Point) • What is a fossil? • How do fossils form? • Why is the fossil record incomplete? • How do fossils support evolution? • Why are scientists uncertain about how life first began? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported interpretation and explanation. Pupils • Match fossil formation methods to descriptions. • Interpret images of fossils. • Identify evidence for evolutionary change. Teacher Role • Model first examples. • Reinforce scientific vocabulary. • Address misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils:			

	- Describe fossil formation. - Explain why fossils are useful evidence. - Explain why the fossil record is incomplete. - Use fossil evidence to explain evolution. Suggested Activities - Fossil formation sequencing task. - Diagram annotation. - Fossil evidence case study. - GCSE-style extended response. Teacher Flexibility Teachers select format based on class need: - Timeline activity. - Sequencing cards. - Fossil image analysis. - Structured written explanation. Success Criteria - Define fossil accurately. - Describe fossil formation. - Explain why fossils provide evidence for evolution. - Explain why the fossil record is incomplete. - Use scientific vocabulary correctly. Adaptation Prompts If pupils struggle - Use visual sequences of fossil formation. - Provide sentence starters. - Scaffold explanations using diagrams. If secure - Evaluate fossil evidence critically. - Explain limitations of the fossil record. - Analyse evolutionary changes using fossil examples.			
Support / Diamond (challenge)	Support - Fossil formation flow chart. - Vocabulary mat. - Sequencing scaffold. Example sentence starters: “A fossil forms when _____.”			

	“Fossils provide evidence for evolution because _____.” Diamond (Challenge) - Evaluate why fossil evidence is important despite being incomplete. - Compare different methods of fossil formation. - Analyse how fossils support Darwin's theory of evolution.			
Common misconceptions	- Fossils are simply old bones. - Every organism becomes fossilised after death. - Fossils provide complete information about past life. - Fossils prove exactly how life began. - Evolution occurred suddenly rather than gradually.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define fossil. - Describe one method of fossil formation. - Explain why fossils provide evidence for evolution. - Explain why the fossil record is incomplete. Diagnostic Focus Can pupils: - Describe fossil formation? - Explain why fossils are evidence? - Evaluate limitations of fossil evidence? - Use scientific vocabulary accurately?			
Exit ticket (5 mins)	Purpose Inform planning for B6.11 Antibiotic Resistance Example Questions - What is a fossil? - How can fossils support the theory of evolution? - Why is the fossil record incomplete? Teacher uses responses to identify misconceptions before applying natural selection to antibiotic resistance.			

Adaptive teaching	• Retrieval strengthens understanding of evolution and natural selection. • Hinge questions identify misconceptions about evidence. • Visual models support understanding of fossil formation. • Vocabulary is explicitly taught and revisited. • Challenge develops evaluation and evidence-based reasoning. • Exit ticket informs progression to antibiotic resistance.			
British Values	Tolerance - Students recognise that scientific explanations develop as new evidence becomes available and that uncertainty is a normal part of scientific enquiry. Individual Liberty - Students independently evaluate fossil evidence and use it to construct scientific explanations.			
Teacher Notes for MTP adaptations				

B6.11 Antibiotic Resistance		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- State why bacteria evolve rapidly - Explain how antibiotic resistance develops by natural selection - Discuss how the development of antibiotic-resistant strains can be reduced	Analyse how natural selection leads to the development of antibiotic resistance. Apply knowledge of evolution and mutation to explain how resistant bacterial populations increase over time. Evaluate strategies used to reduce the development and spread of antibiotic-resistant bacteria.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how evolutionary processes can be observed in modern populations. WS 3.5 (Interpret Data) Interpret information about bacterial populations and resistance trends. WS 3.6 (Explain using Evidence) Explain antibiotic resistance using natural selection and mutation. WS 3.7 (Evaluation) Evaluate methods used to reduce resistance. WS 4.1 (Scientific Vocabulary) Use terms such as antibiotic resistance, mutation, selection pressure and pathogen accurately. Maths Skills 1c (Comparisons) Compare resistant and non-resistant bacterial populations. 2c (Patterns and Relationships) Identify patterns in bacterial growth and resistance development.	EEF 4 (Memory): Retrieve prior learning about evolution, mutation and natural selection. EEF 3 (Modelling): Model how resistance develops through selection pressure. EEF 6 (Language): Explicit teaching of specialist medical and evolutionary vocabulary. EEF 7 (Feedback): Feedback used to improve scientific explanations and evaluations.
Do Now (5 mins)	Purpose Retrieve prior learning about evolution, variation and mutation. Suggested Structure (teacher adapts) - What is a mutation? - What is natural selection? - What is a pathogen? Diamond (Challenge) - Why might some bacteria survive exposure to an antibiotic? Teacher Uses Responses To - Assess understanding of evolution. - Identify misconceptions about antibiotic use. - Prepare pupils for applying natural selection to bacteria.			
Hook / Intro (5 mins)	Introduce Key Idea “Why are some bacterial infections becoming more difficult to treat?” Suggested Strategy Present two scenarios: - An antibiotic successfully treats an infection. - The same antibiotic no longer works on a different patient with a similar infection. Ask: - Why might the medicine stop working? - Have the bacteria changed? - How could evolution happen so quickly? Pedagogical Rationale Provides a real-world application of natural selection and demonstrates why evolution remains important today.			
Direct Teaching:	Content: Antibiotic Resistance			

Cell Structure (10 – 15 mins)	Recap: Antibiotics • Kill bacteria or prevent them reproducing. • Do not work against viruses. Why Bacteria Evolve Rapidly Explain: • Bacteria reproduce very quickly. • Large populations are produced. • Mutations occur frequently. • Beneficial mutations spread rapidly. How Resistance Develops Step 1 A bacterial population contains variation. Some bacteria possess a mutation that makes them less affected by an antibiotic. Step 2 The antibiotic is used. Most bacteria are destroyed. Resistant bacteria survive. Step 3 Resistant bacteria reproduce. Their offspring inherit the resistance. Step 4 The proportion of resistant bacteria increases. The antibiotic becomes less effective. Key Idea Antibiotic resistance develops through natural selection. The antibiotic acts as a selection pressure. Reducing Antibiotic Resistance Examples: • Only prescribing antibiotics when necessary. • Completing the full course of treatment. • Avoiding the use of antibiotics for viral infections. • Improving hygiene and infection control.			
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	Teacher Modelling (EEF 3) Model sequence: Mutation → Variation → Antibiotic used → Resistant bacteria survive → Reproduction → Resistance increases Model explanation: “The antibiotic does not create resistance. The mutation already exists. The antibiotic simply gives resistant bacteria a survival advantage.” Check for Understanding (Hinge Point) • Why do bacteria evolve rapidly? • What is antibiotic resistance? • What is a mutation? • How does natural selection increase resistance? • How can people help reduce resistance? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported sequencing and explanation. Pupils • Sequence stages of resistance development. • Match terms to definitions. • Explain how resistance develops using structured prompts. Teacher Role • Model first examples. • Reinforce evolutionary vocabulary. • Correct misconceptions immediately. •			
Main Task (20 mins)	Core Task Pupils: • Explain how antibiotic resistance develops. • Link mutation, variation and natural selection. • Evaluate methods used to reduce resistance. • Apply understanding to real-world healthcare scenarios. Suggested Activities • Resistance flow chart • Antibiotic resistance case study			

	• Cause-and-effect sequencing task • GCSE-style extended response question Teacher Flexibility Teachers select format based on class need: • Sequencing cards • Diagram annotation • Structured worksheet • Evaluation task Success Criteria • Define antibiotic resistance. • Explain how resistance develops. • Link resistance to natural selection. • Evaluate strategies to reduce resistance. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Use visual flow diagrams. • Provide sentence starters. • Use keyword matching tasks. If secure • Analyse resistance in unfamiliar pathogens. • Explain why resistance spreads quickly through populations. • Evaluate public health strategies.			
Support / Diamond (challenge)	Support • Antibiotic resistance flow chart. • Vocabulary mat. • Sequencing scaffold. Example sentence starters: “Resistance develops because ____.” “The mutation allows bacteria to ____.” “Resistance can be reduced by ____.” Diamond (Challenge) • Explain why resistance is an example of evolution in action. • Analyse why antibiotic resistance is considered			

	a global health issue. Evaluate which strategy is most effective in slowing resistance			
Common misconceptions	- Antibiotics create resistant bacteria. - People become resistant to antibiotics. - Antibiotics kill viruses. - Mutations are always harmful. - Resistance develops because bacteria “need” to survive.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define antibiotic resistance. - Explain how resistance develops. - Define mutation. - State one way resistance can be reduced. Diagnostic Focus Can pupils: - Explain the role of mutation? - Link resistance to natural selection? - Describe the development of resistance accurately? - Evaluate prevention strategies?			
Exit ticket (5 mins)	Purpose Inform planning for B6.12 Classification Example Questions - What is antibiotic resistance? - How does natural selection contribute to resistance? - Give one way resistance can be reduced. Teacher uses responses to identify misconceptions before moving into classification and evolutionary relationships.			
Adaptive teaching	- Retrieval links variation, mutation and evolution. - Hinge questions identify misconceptions about antibiotics. - Visual sequences reduce cognitive load. - Vocabulary is explicitly taught and revisited. - Challenge develops application and evaluation			

	skills. Exit ticket informs progression to classification.			
British Values	Rule of Law - Students understand the importance of following medical advice and responsible antibiotic use. Individual Liberty - Students recognise how personal choices can influence public health and antibiotic resistance.			
Teacher Notes for MTP adaptations				

B6.12 Classification		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Use the binomial naming system correctly - Explain why classification systems have changed over time - Interpret evolutionary trees to identify relationships between organisms	Analyse how classification systems have changed as scientific knowledge has improved.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific ideas and models develop as evidence improves. WS 3.5 (Interpret Data) Interpret evolutionary trees and classification diagrams. WS 3.6 (Explain using Evidence) Explain how evidence supports classification decisions. WS 3.7 (Evaluation) Evaluate different classification systems using evidence. WS 4.1 (Scientific Vocabulary) Use terms such as classification, species, binomial system, evolutionary tree and organism accurately.	EEF 4 (Memory): Retrieve prior learning about evolution, variation and natural selection. EEF 3 (Modelling): Model how to interpret evolutionary trees and use binomial names correctly. EEF 6 (Language): Explicit teaching of classification and taxonomy vocabulary. EEF 7 (Feedback): Feedback used to improve interpretation of biological evidence and scientific explanations.
Do Now (5 mins)	Purpose Retrieve prior learning about evolution, fossils and evolutionary relationships. Suggested Structure (teacher adapts) - What is evolution? - What is a species? - How do fossils provide evidence for evolution? Diamond (Challenge) - Why might scientists need a system for organising millions of different organisms? Teacher Uses Responses To - Assess understanding of evolution and biodiversity. - Identify misconceptions about species and classification. - Establish links between evolution and classification.	Apply evidence from evolutionary trees to determine relationships between organisms. Evaluate why modern classification systems are more reliable than early classification systems.		
Hook / Intro (5 mins)	Introduce Key Idea “How do scientists organise the enormous variety of life on Earth?” Suggested Strategy Display: - A lion - A domestic cat - A wolf - A mushroom - A bacterium Ask: - Which organisms appear most similar? - How should scientists decide which organisms are related? - Should appearance alone be enough? Pedagogical Rationale		Maths Skills 1c (Comparisons) Compare similarities and differences between organisms. 2c (Patterns and Relationships) Identify relationships shown in classification systems and evolutionary trees.	

	Creates a genuine need for classification systems and highlights the challenge faced by biologists.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Classification Introduce: Classification - The process of organising living organisms into groups based on similarities and differences. Why Classify Organisms? Classification helps scientists: - Identify organisms. - Study relationships between organisms. - Communicate consistently. - Understand evolutionary history. The Binomial Naming System Introduce: All organisms receive a unique scientific name made up of two parts: Example <i>Homo sapiens</i> Where: - First word = Genus - Second word = Species Explain: - Scientific names are used worldwide. - This avoids confusion caused by common names. Development of Classification Systems Early Classification Scientists originally grouped organisms using: - Observable features - Appearance - Habitat Limitations: - Organisms may appear similar but not be closely related. Modern Classification Scientists now use:			

	- Physical characteristics - Genetic evidence - DNA analysis - Evolutionary relationships Key Idea Classification systems change when new evidence becomes available. Evolutionary Trees Introduce: Evolutionary Tree - A diagram showing relationships between organisms and their common ancestors. Explain: - Organisms sharing a more recent common ancestor are more closely related. - Branching points represent evolutionary divergence. Teacher Modelling (EEF 3) Model reading an evolutionary tree: Ask: - Which two organisms are most closely related? - Which organisms share the most recent common ancestor? - Which organism diverged first? Model explanation: “Organisms positioned on nearby branches are usually more closely related because they share a more recent common ancestor.” Check for Understanding (Hinge Point) - What is classification? - Why do scientists use binomial names? - Why has the classification system changed over time? - What does a branching point represent on an evolutionary tree? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported interpretation and classification. Pupils			

	• Match scientific names to organisms. • Interpret simple evolutionary trees. • Identify similarities and differences between classification systems. Teacher Role • Model first examples. • Reinforce scientific vocabulary. • Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Use the binomial system correctly. • Explain why classification systems have changed. • Interpret evolutionary trees. • Explain how modern classification reflects evolutionary relationships. Suggested Activities • Binomial naming task. • Evolutionary tree interpretation. • Classification comparison table. • GCSE-style extended response. Teacher Flexibility Teachers select format based on class need: • Evolutionary tree card sort. • Classification worksheet. • Species matching activity. • Structured written explanation. Success Criteria • Define classification accurately. • Use binomial names correctly. • Explain why classification systems have changed. • Interpret evolutionary trees successfully. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Provide labelled evolutionary trees. • Use scaffolded interpretation questions. • Provide classification vocabulary support.			

	If secure - Analyse more complex evolutionary trees. - Explain how DNA evidence changed classification. - Evaluate historical and modern systems.			
Support / Diamond (challenge)	Support - Classification fact sheet. - Evolutionary tree guide. - Vocabulary mat. Example sentence starters: "The binomial name of an organism consists of _____." "Classification systems have changed because _____." "These organisms are closely related because _____." Diamond (Challenge) - Evaluate why DNA evidence is important for classification. - Analyse complex evolutionary trees. - Explain why classification is continually updated as scientific understanding develops.			
Common misconceptions	- Organisms are classified only by appearance. - Scientific names are random labels. - Species and genus mean the same thing. - Classification systems never change. - Organisms close together on an evolutionary tree are always living in the same habitat. - Evolutionary trees show which organisms are "better" or "more evolved".			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define classification. - Explain the purpose of binomial naming. - Interpret a simple evolutionary tree. - Explain why classification systems have changed. Diagnostic Focus			

	Can pupils: • Use binomial names correctly? • Explain why classification has developed? • Interpret evolutionary trees? • Use scientific vocabulary accurately?			
Exit ticket (5 mins)	Purpose Review and consolidate learning from the entire B6 Inheritance, Variation and Evolution topic. Example Questions • What is classification? • What is the purpose of the binomial system? • What can evolutionary trees tell us about organisms? Teacher uses responses to identify areas for revision and future retrieval activities.			
Adaptive teaching	• Retrieval strengthens understanding of evolution and biodiversity. • Hinge questions identify misconceptions about classification and evolutionary relationships. • Visual models support interpretation of complex diagrams. • Vocabulary is explicitly taught and revisited. • Challenge develops analysis and evaluation skills. • Exit ticket informs end-of-topic revision planning.			
British Values	Democracy - Students discuss and justify how scientific evidence is used to classify organisms and determine relationships. Tolerance - Students recognise that scientific classification systems change as new evidence becomes available.			
Teacher Notes for MTP adaptations				