Meden School Curriculum Planning							
Subject	Biology Triple	**Year Group**	11	**Sequence No.**		**Topic**	itance, Variation lution

Retrieval	Core Knowledge	Student Thinking
What do teachers need **retrieve** from students before they start teaching **new content**?	What **specific ambitious knowledge** do teachers need teach students in this sequence of learning?	What real life examples can be applied to this sequence of learning to **development of our students thinking, encouraging them to see the inequalities around them** and 'do something about them!'
KS3 Learning **Year 7** Reproduction topic Introduced to the structure of egg and sperm cells. **Year 8** Inheritance topic Introduction to gametes, fertilisation within animals. Understanding of characteristics coming from both genetic and environmental. Selective breeding of animals and cloning of plants. Darwin vs Linnaeus Formation of fossils. Plant structure topic Introduction to pollination and fertilisation in flowering plants. **Year 9** Cell structure topic	**L1: DNA** DNA stands for **deoxyribonucleic acid**, it's the chemical that all of the genetic material in a cell is made up from. DNA determines what inherited **characteristic**s you have. DNA is found in the nucleus of animal and plant cells in the form of **chromosomes**, which are normally in pairs. DNA is a **polymer.** It's made up of two strands coiled together in the shape of a **double helix.** A **gene** is a small section of DNA found on a chromosome. Each gene codes for a particular sequence of **amino acids** which are put together to make a specific **protein**. Only **20 amino acids** are used, but they make 1000s of different proteins. Genes tell us what order to put the amino acids in. DNA determines what protein a cell produces and so what kind of cell it is. **L2: The Genome** **Genome** is the entire set of genetic material in an organism. Scientists know the whole human genome. It allows scientists to identify genes that are linked to different types of **diseases**. This can lead to developing effective **treatments. Migration patterns** can be traced. All modern humans are descended from a **common ancestor** who lived in **Africa.** The human genome is mostly identical in individuals, but as different populations migrated away from Africa, they gradually developed tiny **differences** in their genomes. Scientists can work out when populations **split off** and what **route** they took. **L3: Nucleotides & Protein Synthesis** Each **nucleotide** consists of **one sugar molecule, one phosphate molecule** and **one base.** The sugar	L2: The human genome Discuss the importance of understanding the human genome. E.g., the search for genes linked to different types of disease understanding and treatment of inherited disorders use in tracing human migration patterns from the past. L5: Sex determination Students could explore the differences between biological sex and gender to link to LGBTQ+ L9: Genetic disorders Students should make informed judgements about the economic, social and ethical issues concerning embryo screening, given appropriate information.

The organelles within prokaryotic and eukaryotic cells. Examples of eukaryotic and prokaryotic cells. That prokaryotic cells contain a plasmid.	and phosphate form a backbone and alternate. One of four different bases (**A, T, C and G**) join each sugar. Each base links to a base on the opposite strand in the helix, **A with T and C with G.** This is called **complementary base pairing**. Each amino acid is coded for by a sequence of **three bases.** There are parts of DNA that don't code for proteins. Some of these **non-coding** parts **switch genes on and off**, so they control whether the gene if **expressed or not.** Proteins are made in the cytoplasm at the ribosomes. They use the code in the DNA which cannot move out of the nucleus as it's too big. **mRNA** is made by copying the code from DNA. It acts as a messenger between the DNA and ribosomes. The correct amino acids are brought to the ribosomes in the correct order by the carrier molecules. When the chain of proteins has been assembled, it **folds** into a **unique shape** which allows the protein to perform the task it's meant to do. **Enzymes** act as biological catalysts. **Hormone**s carry messages around the body. **Structural proteins** are physically strong such as collagen that strengthens connective tissue. **<u>L4: Mutations</u>** A **mutation** is a random change. They can be **inherited** and occur **continuously**. Mutations can also be **spontaneous.** The chance is increased when exposed to **certain substances** or some types of **radiation**. Mutations change the sequence of the DNA bases in a gene which produces a **genetic variant** and can lead to changes in the protein coded for. Most mutations have **very little or no effect** on the protein. An altered protein can have a change in shape which alters its function. If the mutation is in the non-coding DNA, it can alter how genes are expressed. **Insertions** are when a new base is inserted in the DNA base sequence where it shouldn't be. This changes the way the three bases are read which can change the amino acids they code for. They can change more than one amino acid as they have a knock-on effect. **Deletions** are when a random base is deleted from the DNA base sequence. They change the way the base sequence is read and have a knock-on effect too. **Substitution**s are when a random base in the DNA base sequence is changed to a different base. **<u>L5: Meiosis</u>** **Meiosis** halves the number of **chromosomes** in **gametes** and **fertilisation** restores the full number of **chromosomes**. Cells in **reproductive organs** divide by **meiosis** to form **gametes**. When a cell divides to form **gametes**: copies of the **genetic** information are made, the **cell divides** twice to form **four gametes**, each with a **single** set of **chromosomes** all gametes are **genetically different** from each other.	<u>L23 & 24 – Antibiotics and Antibiotic resistance</u> Students to explore what can be done to stop drug resistant pathogens emerging. Oracy opportunity of factsheets for 'doctors' or 'public' and then present to the class.

Gametes join at **fertilisation** to restore the normal number of **chromosomes**. The new cell divides by **mitosis**. The number of cells increases. As the **embryo** develops cells **differentiate**.

Ordinary human body cells contain **23 pairs** of **chromosomes**.22 pairs control **characteristics** only, but one of the pairs carries the **genes** that determine **sex**. In **females** the **sex chromosomes** are the same **(XX)**. In **males** the **chromosomes** are different **(XY).**

<u>L6: Sexual vs Asexual reproduction</u>

Sexual reproduction involves the joining (**fusion**) of male and female **gametes**:
sperm and **egg cells** in animals
pollen and **egg cells** in flowering plants.

In **sexual reproduction** there is mixing of **genetic** information which leads to **variety** in the offspring. The formation of **gametes** involves **meiosis**.

Asexual reproduction involves only one parent and no fusion of **gametes**. There is no mixing of **genetic** information. This leads to **genetically identical** offspring (**clones**). Only **mitosis** is involved.

<u>L7: Advantages and Disadvantages</u>

Advantages of sexual reproduction:

- produces **variation** in the offspring
- if the environment changes variation gives a **survival advantage** by **natural selection**
- natural selection can be speeded up by humans in **selective breeding** to increase food production.

Advantages of asexual reproduction:

- only one parent needed
- more time and **energy efficient** as do not need to find a mate
- faster than sexual reproduction
- many identical offspring can be produced when conditions are favourable

Some organisms reproduce by both methods depending on the circumstances.

Malarial parasites reproduce asexually in the human host, but sexually in the mosquito.

Many **fungi** reproduce asexually by spores but also reproduce sexually to give variation.

Many plants produce seeds sexually, but also reproduce asexually by runners such as **strawberry plants, or bulb division such as daffodils.**

L8: Genetic inheritance

Some **characteristics** are controlled by a single **gene**, such as: fur colour in mice; and red-green colour blindness in humans. Each **ge**ne may have different forms called **alleles**.

The **allele**s present, or **genotype**, operate at a **molecula**r level to develop **characteristics** that can be **expressed** as a **phenotype**.

A **dominant allele** is always expressed, even if only one copy is present. A **recessive allele** is only expressed if two copies are present (therefore no **dominant allele** present).

If the two **alleles** present are the same the **organism** is **homozygous** for that trait, but if the **alleles** are different they are **heterozygous**.

Most **characteristics** are a result of multiple **genes** interacting, rather than a single gene.

L9: Punnet Squares

Students should be able to understand the concept of **probability** in predicting the results of a **single gene** cross but recall that most **phenotype** features are the result of **multiple genes** rather than single gene **inheritance**.

Students should be able to use **direct proportion** and **simple ratios** to express the outcome of a **genetic cross**.

Students should be able to complete a **Punnett square** diagram and **extract** and **interpret** information from **genetic crosses** and **family trees**.

Disorders are **inherited**. These **disorders** are caused by the **inheritance** of certain **alleles**. **Polydactyly** (having extra fingers or toes) is caused by a **dominant allele**.

Cystic fibrosis (a disorder of cell membranes) is caused by a **recessive allele**.

L10: Screening Embryos

Embryo screening can help to identify if an offspring will have a **genetic disorder**. There are **economic**, **social** and **ethical** issues concerning **embryo** screening to consider with **embryo** screening.

L11: Work of Mendel

In the mid-19th Centaury Mendel noted how characteristics in plants were passed on from one

	generation to the next. The results were published in **1866** and became the foundation of **modern genetics.** He showed that the height characteristic in pea plants was determined by separately inherited **('hereditary units')** passed on from each parent. The ratios of tall and dwarf plants in the offspring showed that the unit for tall plants 'T' was dominant over the unit for dwarf plants 't'. He determined that characteristics in plants are determined by hereditary units. They are passed on to offspring **unchanged** from both parents, one unit from each parent. They can also be **dominant** or **recessive.** Mendel's work was cutting edge and new. The background knowledge to understand his findings was not available, they had no idea about genes, DNA and chromosomes. It wasn't until after his death that people realized how significant Mendel's work was. His work was the starting point for the understanding of genes today. In the late 1800s, scientists became familiar with chromosomes, they observed how they behaved during cell division. In the early 20th century, scientists realized there was similarities in the way chromosomes and 'hereditary units' acted. It was proposed that the 'units' were found on chromones and now we call them genes. In **1953**, the structure of DNA was determined so scientists found out how genes work. **<u>L12: Variation</u>** The **genome** and its interaction with the environment influence the development of the **phenotype** of an **organism**. Differences in the **characteristics** of individuals in a population are called **variation** and may be due to differences in: the **genes** they have **inherited** (genetic causes) , the **conditions** in which they have **developed** (environmental causes) or a **combination** of **genes** and the **environment.** There is usually extensive **genetic variation** within a **population** of a **species** recall that all **variants** arise from **mutations** and that: most have no effect on the **phenotype**; some influence **phenotype**; very few determine **phenotype**. **Mutations** occur continuously. Very rarely a **mutation** will lead to a new **phenotype**. If the new **phenotype** is suited to an **environmental change** it can lead to a relatively **rapid change** in the **species e.g., the peppered moth.** **<u>L13 & L14: Evolution</u>** The theory of **evolution** by **natural selection** states that all **species** of living things have **evolved** from simple life forms that first developed more than three billion years ago. **Evolution** occurs through	

	natural selection of **variants** that give rise to **phenotypes** best suited to their **environment**. The **theory of evolution by natural selection** is now widely accepted. Evidence for **Darwin's theory** is now available as it has been shown that **characteristics** are passed on to **offspring** in **genes**. There is further evidence in the **fossil** record and the knowledge of how **resistance** to **antibiotics evolves** in **bacteria**.**Extinctions** occur when there are no remaining individuals of a **species** still **alive**.Students should be able to **describe factors** which may contribute to the **extinction** of a **species**. **<u>L15 & L16: Selective Breeding</u>** **Selective breeding** (artificial selection) is the process by which humans breed plants and animals for **desired genetic characteristics**. Humans have been doing this for thousands of years since they first bred food crops from wild plants and domesticated animals. **Selective breeding** involves choosing **parents** with the **desired characteristic** from a mixed population. They are bred together. From the **offspring** those with the **desired characteristic** are bred together. This continues over many **generations** until all the **offspring** show the **desired characteristic**. The characteristic can be chosen for usefulness or appearance: **Disease resistance** in food crops. Animals which **produce more meat or milk**. Domestic dogs with a gentle nature. Large or unusual flowers. **Selective breeding** can lead to **'inbreeding**' where some breeds are particularly **prone to disease or inherited defects.** **<u>L17 & L18: Genetic Engineering</u>** **Genetic engineering** is a process which involves **modifying** the **genome** of an **organism** by introducing a **gene** from another **organism** to give a **desired characteristic**. Plant crops have been **genetically engineered** to be **resistant** to **diseases** or to produce bigger, better fruits. **Bacterial cells** have been **genetically engineere**d to produce useful **substances** such as human **insulin** to treat **diabetes**.	

	(HT only) In genetic engineering: • **Enzymes** are used to **isolate** the required **gene;** this gene is inserted into a **vector**, usually a **bacterial plasmid** or a **virus** • The **vector** is used to **insert** the **gene** into the **required** cells • **Genes** are transferred to the cells of animals, plants or microorganisms at an early stage in their development so that they develop with **desired characteristics**. The **benefits** and **risks** of **genetic engineering** in **agriculture** and in **medicine** and that some people have objections. In **genetic engineering**, **genes** from the **chromosomes** of humans and other **organisms** can be 'cut out' and transferred to cells of other **organisms**. Crops that have had their **genes** modified in this way are called **genetically modified (GM)** crops. **GM crops** include ones that are **resistant** to insect attack or to **herbicides**. **GM crops** generally show **increased yields**. Concerns about **GM crops** include the effect on **populations** of **wild flowers** and **insects**. Some people feel the effects of eating **GM crop**s on human **healt**h have not been fully explored. Modern medical research is exploring the possibility of **genetic modification** to overcome some **inherited disorders**. **L19: Plant Cloning** **Tissue culture**: using small groups of cells from part of a plant to grow identical new plants. This is important for **preserving rare plant** species or commercially in nurseries. **Cuttings**: an older, but simple, method used by gardeners to produce many identical new plants from a parent plant. **L20: Animal Cloning** **Embryo transplants**: splitting apart cells from a developing animal embryo before they become specialized, then transplanting the identical embryos into host mothers. Adult cell cloning:	

	• The nucleus is removed from an unfertilized egg cell. • The nucleus from an adult body cell, such as a skin cell, is inserted into the egg cell. • An **electric shock** stimulates the egg cell to divide to form an embryo. • These embryo cells contain the same genetic information as the adult skin cell. When the embryo has developed into a ball of cells, it is inserted into the womb of an adult female to continue its development. **<u>L21: Fossils</u>** **Fossils** are the '**remains**' of **organisms** from millions of years ago, which are found in rocks. Many early forms of life were **soft-bodied**, which means that they have left few traces behind. What traces there were have been mainly destroyed by **geological activity**. Therefore, scientists cannot be certain about how life began on Earth. **Phylogenic trees** can be used to show how different **species** have **evolved** over time and who their closest/most distant **ancestor species** were. **Fossils** may be formed: • from parts of **organisms** that have not **decayed** because one or more of the conditions needed for **decay** are absent. • when parts of the **organism** are replaced by **minerals** as they **decay.** • as **preserved** traces of **organisms**, such as **footprints, burrows** and **rootlet** traces. **<u>L22: Speciation</u>** A **species** is a group of similar organisms that can reproduce to give **fertile offspring. Speciation** is the development of a new species. It occurs when populations of the same species become so different, they can no longer **successfully interbreed** to produce fertile offspring. **Isolation** is where populations of a species are separated. This can happen due to a **physical barrier. Conditions** on the other side will be slightly different so different characteristics will become more popular in the populations due to natural selection. **Alfred Russel Wallace** was working at the same time as **Charles Darwin**, he was one of the early scientists working on **speciation** (this and **warning colours** is what he is most famous for). His observations contributed greatly to our understanding today which has developed as more evidence has come available over time. Wallace independently came up with the idea of natural selection and published work on the subject with Darwin in **1858** wish prompted Darwin to publish **'On the Origin of Species'** in **1859.**	

	<u>L23 & 24: Antibiotics and Antibiotic Resistance</u> **Antibiotics**, such as **penicillin**, are medicines that help to cure **bacterial disease** by killing **infective bacteria** inside the body. It is important that specific **bacteria** should be treated by specific **antibiotics**. **Bacteria** can **evolve** rapidly because they **reproduce** at a fast rate. **Mutations** of **bacterial pathogens** produce new **strains**. Some **strains** might be **resistant** to **antibiotics**, and so are not killed. They **survive** and **reproduce**, so the population of the **resistant strain rises**. The **resistant strain** will then spread because people are not **immune** to it and there is no effective treatment. **MRSA** is resistant to antibiotics. To reduce the rate of development of **antibiotic resistant** strains: Doctors should not prescribe **antibiotics** inappropriately, such as treating non-serious or **viral infections.** Patients should complete their course of **antibiotics** so all **bacteria** are killed and none **survive to mutate** and form **resistant strains.** The **agricultural** use of **antibiotics** should be restricted. The **development** of new **antibiotics** is costly and slow. It is unlikely to keep up with the emergence of new **resistant** strains **<u>L25 & L26: Classification</u>** In the **1700s Carl Linnaeus** classified organisms into groups according to their characteristics and structures. This was known as the **Linnaean System**. Organism are first divided into **kingdoms**, then subdivided into smaller groups: **phylum, class, order, family, genus and species**. As knowledge of **biochemical processes** taking place inside organisms developed **and microscopes improved** scientists put forward new models of classification. In **1990 Carl Woese** proposed the **three-domain system.** Using RNA analysis technique he found, in some cases, that species thought to be closely related were not. Before kingdom the three domains are **archaea** (primitive bacteria found in extreme places) **bacteria** (true bacteria, they look similar to archaea but there are a lot of biochemical differences between them) and **eukaryota** (broad range of organisms such as fungi, plants, animals and protists).	

	In the **binomial system**, every organism has a **two-part Latin name**. The first name is the **genus** and the second name is the **species**. This is used **worldwide** so scientists from different countries or who speak different languages all refer to a particular species with the same name, avoiding confusion. **Evolutionary trees** show how scientists think species are related to each other. They show **common ancestors** and relationships between different species. The more recent the common ancestor the more closely related the two species and the more characteristics they are likely to share. Scientists analyze lots of different types of data to work out evolutionary relationships. For currently living organisms they use current classification data (e.g. **DNA analysis**) and for **extinct** species they use **fossil records.** **L27: Revision** **L28: EoTT** **L29: GPA**	