# Scheme of Work 2020-2021
# Subject: Biology

**Year Group: 12 Summer Term 1**
**Specification: AQA**

| Lesson No | Topic & Objectives | Big Question – What will students learn? | Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary | Planned Assessment | Homework or flipped learning resources<br><br>DODDLE resources | Lit Num SMSC Codes |
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| 1<br>**3.4.1 DNA, genes and chromosomes.** cholesterol | Eukaryotic cells have chromosomes of linear DNA associated with histones.<br><br>Prokaryotic cells contain short, circular DNA that is not associated with histones.<br><br>Mitochondria and chloroplasts contain DNA like that of prokaryotes.<br><br>A gene is a base sequence of | • Explain what is meant by the terms chromosome and gene.<br>• Compare and contrast DNA in eukaryotes with that in prokaryotes, mitochondria and chloroplasts.<br>• Explain what a gene could code for. | **Learning activities:**<br>• questioning from GCSE about the meaning of key terms like gene, chromosome and allele<br>• use animation to show scale of chromosomes in eukaryotic cells and how chromosomes are made of DNA and histones. Introduce the concept of a gene<br>• teacher explanation about the difference between the arrangement of DNA in prokaryotic cells and eukaryotic cells<br>• students generate a summary table comparing and contrasting prokaryotic and eukaryotic DNA.<br><br>**Skills developed by learning activities:**<br>• MS 0.2 – students can be introduced to base pairs/kilobase pairs as a measuring of length when discussing the loci of a gene on a chromosome and convert this from standard to ordinary form<br><br>AO1 – development of knowledge and understanding of the arrangement of DNA in eukaryotes and prokaryotes and the | | yourgenome.org/teachers/zoom.shtml<br><br>**Rich question:**<br>A textbook stated that "The bacterial chromosome is found in the cytoplasm of the cell". Evaluate this statement. | C1,C3,Sp2 |

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| | DNA that codes for the amino acid sequence of a polypeptide or a functional RNA. | | relationship between DNA, genes and chromosomes. | | | |
| 2 | DNA has a triplet code which is universal, non-overlapping and degenerate.<br><br>Much of eukaryotic DNA does not code for polypeptides. There are non-coding regions of multiple base repeats between genes. There are also introns within genes which separate coding sequences (exons). | • Explain how the DNA base sequence is able to code for the primary structure of a polypeptide.<br>• Explain the terms degenerate, universal and non-overlapping.<br>• Explain why much of eukaryotic DNA can be considered as non-coding.<br><br>Explain what is meant by an intron and an exon | **Learning activities:**<br>• remind students that there are 20 amino acids and only 4 bases. Ask how many bases would have to code for an amino acid to give sufficient combinations<br>• teacher explanation of the triplet code and the fact that there is degeneracy (as well as the fact it is universal and non-overlapping)<br>• ask the rich question: how many bases code for a polypeptide of 24 amino acids<br>• explain why the answer might in fact be more than 72 as there are introns in the gene. Introduce the idea of introns and also non-coding regions between genes<br>• exam questions.<br><br>**Skills developed by learning activities:**<br>• MS 0.3 – students could calculate the percentage of human DNA which does code for polypeptides, when supplied with data about the number of coding bases and the total number of bases<br>• MS 0.5 – students could work out the possible number of combinations that a triplet code can have (ie 43) to highlight the idea of degeneracy | **Past exam paper material:**<br><br>BIOL2 June 12 Q5b<br><br>BIOL2 June 2011 – Q3a<br><br>BIOL2 Jan 2010 – Q3 | yourgenome.org/teachers/dnaprotein.shtml<br><br>**Rich questions:**<br>• What is meant by the terms:<br>  • degenerate?<br>  • non-overlapping?<br>  • universal?<br><br>A polypeptide is made of 24 amino acids. What is the minimum number of bases that the gene coding for it must have had? | C1,C3,Sp 2 |

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| | | | AO1 – development of knowledge and understanding of the triplet code and non-coding sections of it. | | | |
| 3<br>**3.4.2 Protein synthesis.** | The concept of the genome and the proteome.<br>The structure of molecules of mRNA.<br>The process of transcription in prokaryotes to produce mRNA.<br>The process of transcription in eukaryotes to produce pre-mRNA which is subsequently spliced.. | • Explain what the terms genome and proteome mean.<br>• Describe the structure of mRNA and how it is related to its function (link to 3.1.5.1).<br>• Explain the process of transcription in prokaryotes.<br>• Explain the process of transcription and splicing in eukaryotes, linking this to knowledge of introns.<br>Interpret data from experimental work investigating the role of nucleic acids. | **Learning activities:**<br>• questioning to recap knowledge about the role of DNA and RNA from section 3.1.5<br>• provide students with data from experimental work investigating the role of nucleic acids eg the Hershey-Chase experiment and ask them to interpret this<br>• introduce concept of genome and proteome<br>• teacher explanation of the process of transcription and how the structure of mRNA relates to its function of transferring the code to the ribosomes. Use animation to support this.<br>**Skills developed by learning activities:**<br>• PS 1.2 - apply knowledge of transcription and nucleic acids to explain experimental data from investigations into the role of nucleic acids<br>• AO1 – development of knowledge around transcription and the structure and role of mRNA<br>AO2 – application of knowledge to transcribe a DNA sequence into mRNA | **Past exam paper material:**<br>BIOL5 June 2010 – Q2<br>BIOL5 June 2011 – Q1 | yourgenome.org/teachers/dnaprotein.shtml<br>**Rich questions:**<br>• What are the advantages of mRNA being used to carry the genetic code to the ribosomes, rather than DNA?<br>• Explain how mRNA is adapted to its function.<br>• What is the difference between mRNA and pre-mRNA?<br>Provide students with a DNA code, identify the sense strand and ask students to transcribe it (assuming there are no introns). | So5,Sp2 M2 |
| 4 | The process of translation.<br>The roles of ribosomes, tRNA and ATP. | • Explain the process of translation.<br>• Explain the specific roles of ribosomes, ATP and tRNA in translation. | **Learning activities:**<br>• questioning to recap knowledge about transcription, the role of ribosomes from section 3.2.1 and ATP from section 3.1.6<br>• teacher explanation of the process of translation and how the structure of tRNA relates to its function in delivering the | Students could undertake the investigations/ questions from the following ISAs:<br>BIO3T P14 | yourgenome.org/teachers/dnaprotein.shtml<br>**Rich questions:**<br>• Evaluate the statement “DNA is a | So5,Sp2 M2 |

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| | The structure of molecules of tRNA. | • Describe the structure of tRNA and how it is related to its function.<br><br>Relate the base sequence of nucleic acids to the amino acid sequence of polypeptides, when provided with suitable data about the genetic code. | specific amino acid. Use animation to support this<br>• exam questions.<br><br>**Skills developed by learning activities:**<br><br>• AO1 – development of knowledge around translation and the structure and role of tRNA<br><br>AO2 – application of knowledge to translate a mRNA sequence into a sequence of amino acids. | **Specimen assessment material:**<br><br>A-level Paper 1 (set 1) – Q11.1<br><br>**Past exam paper material:**<br><br>BIOL5 June 2012 – Q1 (except Q1cii and 1d | triplet code which instructs the ribosomes how to make amino acids".<br>• Explain how the structure of tRNA is adapted for its function.<br><br>Provide students with an mRNA code and ask them to translate it into an amino acid sequence (when provided with appropriate information). | |
| 5<br>**3.4.3 Genetic diversity can arise as a result of mutation or during meiosis** | Gene mutations arise spontaneously during DNA replication and include base deletion and base substitution.<br><br>The degeneracy of the genetic code means that not all base substitutions cause a change in the | • Explain what a gene mutation is and how it arises.<br>• Explain what is meant by a deletion and substitution mutation and the potential consequences of each (linked to primary protein structure).<br>• Interpret base sequences to identify gene mutations and their impact.<br><br>Describe what a mutagenic agent is and identify some possible mutagenic agents. | **Learning activities:**<br><br>• teacher led explanation of how gene mutations arise and mutagenic agents which can increase the risk<br>• students work through the transcription and translation activity (linked in resources). Then ask them to repeat the activity twice more but this time putting in a substitution mutation for one and a deletion mutation for another. Compare effects of the two mutations to the original amino acid sequence. Ask students to relate these effects to their knowledge of protein structure<br>• teacher explanation of the effects of substitution and deletion mutations and also the possible neutral effects of substitution due to degeneracy.<br><br>exam questions | **Specimen assessment material:**<br><br>AS Paper 2 (set 2) – Q3<br><br>**Past exam paper material:**<br><br>BIOL2 Jan 2013 – Q6a–6<br><br>BIOL2 June 2013 – Q7b–7c<br><br>BIOL2 Jan 2012 – Q4<br><br>BIOL2 June 2011 – Q3b<br><br>BIOL2 June 2010 – Q3 | cell-cell-cell.com/wp-content/uploads/CCC_Activity_CrackTheCodon_v01.doc<br><br>**Rich questions:**<br><br>• Evaluate this statement: "Sunbathing exposes your body to UV light which causes mutations to occur".<br>• Which type of gene mutation is likely to be the most damaging and why?<br><br>A student wrote that UV light increased the | Sp3,Sp2 C1 |

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| | amino acid sequence.<br><br>Mutagenic agents can increase the risk of gene mutation. | | **Skills developed by learning activities:**<br><br>• AO1 – development of knowledge around gene mutations and their possible consequences<br><br>AO2 – application of knowledge of mutation to a model of protein synthesis model to suggest possible effects of gene mutation on the structure of the protein produced. | | likelihood of mutations in the protein that the cell made. Why is this not correct? | |
| 6 | Meiosis produces genetically unique daughter cells.<br><br>The process of meiosis involves two nuclear divisions and forms four haploid daughter cells.<br><br>Independent segregation and crossing over result in genetically different daughter cells. | • Explain the different outcome of mitosis and meiosis.<br>• Explain how meiosis results in variation.<br>• Complete diagrams showing the chromosome content of cells after the first and second meiotic division, when given the chromosome content of the parent cell.<br>• Recognise where meiosis occurs when given information about an unfamiliar life cycle.<br><br>Explain how random fertilisation of haploid gametes further increases | **Learning activities:**<br><br>• introduce the convention of 2n and n. Students then calculate the number of possible chromosome combinations (without crossing over)<br>• think, pair, share: there is more variation possible than our calculated number – where does the extra variation come from?<br>• teacher explanation of the process of meiosis, supported by animations and videos<br>• students compare and contrast mitosis and meiosis<br>• students interpret information about unfamiliar life cycles to identify where meiosis and mitosis are occurring.<br><br>**Skills developed by learning activities:**<br><br>• MS 0.5 – use the expression 2n to calculate the possible number of different combinations of chromosomes<br>• MS 0.5 – derive a formula from this to calculate the possible number of different combinations of chromosomes following random fertilisation<br>• 8.4.2.1 and 8.4.2.2 | **Specimen assessment material:**<br><br>A-level Paper 1 (set 1) – Q10; AS Paper 1 (set 1) – Q3.<br><br>**Past exam paper material:**<br><br>BIOL2 June 2013 – Q1; BIOL2 June 2010 – Q5 | nuffieldfoundation.org/practical-biology/preparing-anther-squash<br><br>cleapss.org.uk<br><br>highered.mheducation.com/sites/0072495855/student_view0/chapter3/animation__how_meiosis_works.html<br><br>highered.mheducation.com/sites/0072495855/student_view0/chapter2/animation__comparison_of_meiosis_and_mitosis__quiz_1_.html<br><br>sumanasinc.com/webcontent/animations/content/meiosis.html<br><br>**Rich question:**<br><br>Compare and contrast the similarities and differences | Sp3,Sp2 C1 |

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| | | | • AO1 – development of knowledge of meiosis<br><br>AO2 – application of knowledge to unknown life cycles. | | between mitosis and meiosis. | |
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