Unit 4 Biology

SAC 3 and 4 Information

The final SAC assessment will be completed on **Monday 11th September from 4.00 – 5.15pm** at home campuses.

The questions relate to:

- **SAC 3**: Exploring Marsupial Evolution using Molecular Homology Activity and theory from Key Knowledge 12 - Determining relatedness between species
- **SAC 4**: Biotechnology Activities (Gel Electrophoresis and Bacterial Transformation) and Key Knowledge 14 (DNA Manipulation)

Students should have read Chapters 11 & 13 of the textbook, completed Chapters 3 & 5 of Biology Basics and reviewed the SAC practical activities in preparation for the SAC. Additional revision has also been added to go2 in the SAC folder.

The SAC will be presented in 2 sections (within one booklet)

Each section will contain 10 Multiple Choice + 20 marks of Short Answer Questions; therefore 60 marks overall

An overview of the topics are listed below that can guide student revision.

SAC 3 Study Checklist

Molecular homology as evidence of relatedness between species including DNA and amino acid sequences, mtDNA (the molecular clock) and the DNA hybridisation technique	→ *What is molecular homology?* → *Determining homology from both nucleotide sequences and amino acid sequences* → *Conservative, semi-conservative or non-conservative changes in amino acids & the effect they have on the produced protein* → *What characteristics are looked at when choosing genes to sequence and compare in different species (expressed in similar quantities / performs the same function / similar structure)* → *What are the advantages and disadvantages of using each of these comparative methods (Ad/disad of nucleotide and ad/disad of amino acid sequencing)?* → *Relationship between DNA degeneracy and molecular homology* → *What is mtDNA; where is it found and what is it used for?* → *Difference between mtDNA & nuclear DNA* → *In what situations would you use mtDNA (more recent ancestors) and in what situations would you use nuclear DNA (less recent ancestors) – mutation rate* → *Why use mtDNA in deceased organisms* → *How can mtDNA be used as a molecular clock* → *Advantages / disadvantages of using mtDNA as a molecular clock (mtDNA can only change as a result of mutation – nuclear DNA can mutated & experiences events in meiosis)* → *Limitations of molecular clocks – assumption that mutations occur at a constant rate over time* → *DNA hybridisation technique; process and steps involved; The relationship between temperature and re-hybridisation; applications of the technique*
The use of phylogenetic trees to show relatedness between species	→ *Drawing and reading information from Phylogenetic trees* → *Rooted vs unrooted trees* → *Applications of trees – in what situations are they used* → *The relationship between branch length and species relatedness* → *Limitations of phylogenetic trees* → *How do we determine species age / ancestry from just looking at a phylogenetic tree? (need to compare evidence with fossil record to determine relative age)*
The evolution of novel phenotypes arising from chance events within	→ *What is a Master regulator gene (MrG)* → *Hox gene function & role* → *BMP4 gene function & role*

genomes, specifically sets of genes that regulate developmental processes and lead to changes in the expression of a few master genes found across the animal phyla, as demonstrated by the expression of gene BMP4 in beak formation of the Galapagos finches and jaw formation of cichlid fish in Africa.	→ *What happens when mutations occur in MrG* → *BOTH CASE STUDIES DARWIN'S FINCH BEAKS & AFRICAN CICHILD FISH JAW* → *The process that occurred / how they occurred / evolutionary significance of their occurrence.* → *Why do changes in MrG have such drastic effects on the phenotypes of these organisms* → *What would happen to individuals who have drastic mutations in their MrG?*

SAC 4 Study Checklist

The use of enzymes including endonucleases (restriction enzymes), ligases and polymerases	→ *What are types of endonucleases? What is their role in a cell? How are they used in DNA manipulation techniques? How do they know where to cut the DNA & What types of 'cuts' do they make in the restriction site (Sticky or Blunt ends)?* → *What is the process of reverse transcription?* → *Where is Reverse transcriptase found naturally? What does it produce? How is it used in DNA manipulation techniques?* → *What is the role of DNA polymerase in a cell? How is it used in DNA manipulation techniques? What processes in the cell require this enzyme?* → *What is the role of DNA ligase? How is it used in DNA manipulation techniques?* → *Recap of enzymes & their role in biological processes with reference to the specific ones listed above (Ligase; polymerase; endonuclease; reverse transcriptase)*
Amplification of DNA using the polymerase chain reaction	→ *What is PCR & what is it used for (4 main things)* → *What are the steps in PCR?* → *What are the role of the following in the process – heating the DNA; primers; DNA polymerase; free nucleotides.* → *How does the term 'semi-conservative' mean in relation to PCR?* → *PCR as a 'sensitive' process what are the likely consequences if mistakes are made (EG contamination of DNA; mutation in one of the strands; temperature of the process isn't tightly controlled)*
The use of gel electrophoresis in sorting DNA fragments, including interpretation of gel runs	→ *What is gel electrophoresis and what is it used for?* → *What is the relationship between restriction enzymes and electrophoresis?* → *Why is the electrophoresis subjected to a current and how does this current separate the DNA fragments? (DNA is negatively charged)* → *Which fragments travel the furthest in the gel & how do the fragments travel?* → *What are the ways in which the DNA is treated so that it can be seen in the gel and what relationship does this have with the purpose of its analysis?* → *What is southern blotting?* → *How can gel runs be read or interpreted? DNA sequencing – Sanger method* → *Applications of gel electrophoresis*
The use of recombinant plasmids as vectors to transform bacterial cells.	→ *What does the term vector refer to?* → *What is a bacterial plasmid and how does it differ from a recombinant plasmid?* → *Why are bacteria used for DNA recombinance? (advantages & disadvantages)* → *How are recombinant plasmids a form of gene cloning?* → *What is the relationship between restriction enzymes and DNA recombinance?* → *Examples of case studies which use recombinant plasmids* → *Ethical implications of plasmids*