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*SM3001- Frontiers of Molecular Medical Sciences*

*Course Handbook 2023-2024*

*Undergraduate Medical Sciences*

*School of Medicine, Medical Sciences & Nutrition*

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Course Summary

* While most of the medicines we take are still the standard white-pill small-molecule drugs [e.g. aspirin, ibuprofen, Zantac, Prozac, Viagra], **currently** **the real frontiers of medicine and therapeutics are molecular – including antibodies, gene therapies and vaccines**. There has probably never been a more exciting time to be working at these frontiers – results from trials of new therapies seem to come out weekly. In addition, we have just seen how the biomedical world threw everything it had at Covid and achieved what we previously assumed was impossible: having incredibly-effective vaccines ready within 10 months, rather than the usual 10 years. Thus, it is clear that our frontiers have suddenly shifted and we have underestimated the limits of what can be achieved.
* The modern biologist, if they wish to completely understand and capitalise on the potential of molecular medicine and therapeutics, must not only have exquisite taste in clothing but must also employ a wide range of tools and methodologies drawn from several disciplines. This course is designed to provide students with an understanding of how biological information is obtained and used, drawing on the full range of techniques currently employed in biomedical research. It will provide students with core knowledge facilitating effective study of all fields of modern molecular biology and its subsequent use in the field of medicine and therapeutics. With regard to dress-sense: sorry, there is only so much we can do in one term.
* The Frontiers of Molecular Medical Sciences course, SM3001, runs during the first half-session and it is essential to check that the assessment format will suit you before selecting this course. The first assessment will require considerable amounts of time and effort, backed up by your first conducting independent research on the topic – if you apply yourself and don’t try to cut corners, then precedent suggests that you are likely to get a (very) good grade for this assessment and for this course; if you think to breeze through doing the bare minimum…well, then maybe a course with a different set of assessments might suit you better.

The General Aims of the course are to enable students:

* To establish an understanding of the molecular technologies used by biologists to gain knowledge of molecular cell systems.
* To appreciate the incredible scope of modern molecular medicine and how we can apply it to benefit human health and treat diseases that previously were regarded as beyond our capabilities.
* To obtain a deeper understanding of all the tools that molecular biologists and biomedical scientists now have at their disposal, and to gain an appreciation of how these are being applied as cutting-edge therapies to treat disorders with a genetic basis.
* To establish an appreciation of the advantages and disadvantages of different molecular biological tools, the appropriateness of their application to a given biological problem and how the information from each technique can be integrated.
* To analyse primary experimental results.
* To establish an understanding of how the targets discovered and studied can then be used in applied research and lead to the development of new medicines.
* **To conduct extensive independent background research in support of your essay (worth 30% of your final grade).**

Course Aims & Learning Outcomes

At the end of the course students should be able to -

* Describe and understand the cutting-edge technologies currently being introduced into clinical medicine for the treatment of disorders with a genetic basis;
* Describe and use the basic tools and techniques used in molecular biology, such as enzymes, vectors, recombinant DNA methods, gene cloning, PCR etc;
* Understand how these techniques are used to analyse gene and protein function;
* Describe procedures for expressing foreign genes in appropriate hosts such as bacteria, yeast, insect and mammalian cells (to include transgenic mice in biological research);
* Describe a variety of methods for purifying proteins from tissues or from gene expression systems and also the criteria for selecting particular methods;
* Describe what methods and processes are used to move from disease-relevant genes and proteins, to the use of model systems to probe these processes, and onwards to the ideas that spawn new medicines and new ways of treating disease;
* Understand the journey through from an idea concerning a biological process or target to the starting point for the development of a new therapeutic.

Course Teaching Staff

Course Coordinator:

Dr Iain Greig ([i.greig@abdn.ac.uk](mailto:i.greig@abdn.ac.uk))

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Dr Frank Ward ([f.j.ward@abdn.ac.uk](mailto:f.j.ward@abdn.ac.uk))

All staff teaching on this course are based at the Institute of Medical Sciences (IMS).

Assessments & Examinations

Course assessment for SM3001 consists primarily of continuous assessment – but 30% of your grade will come from essay-style questions in an in-person timed exam and thus it is essential that you engage will all aspects of the course.

**CONTINUOUS ASSESSMENT**. This comprises the following assignments -

ASSIGNMENT VALUE OF FINAL MARK

1. Essay question on gene therapies 30%

2. Practical write up 25%

3. CAL protein purification test 15%

4. Essay-style exam (2 hours) 30%

**IMPORTANT ADDITIONAL DETAILS:**

A number of you may have had limited experience of writing an essay and/or conducting your own independent research on a complex topic. As this essay is compulsory, before selecting this course it is essential that you are aware of the commitment that will be required to achieve a good mark in this assignment. It is also essential that you attend the guidance session on this assignment and, if you are in any way unsure about any aspects of the assignment, that you ASK THE COORDINATOR FOR HELP!!!

Essay (Gene Therapy) Summary: select three diseases with a strong genetic component (i.e. in which a known genetic mutation has led to e.g. a lack of an essential protein, to a poorly functional protein or to the production of a toxic protein responsible for the disease) and a different gene therapy for each (a total of 3 diseases and 3 gene therapies – NOT 3 for each disease); describe the disease background and extent (numbers of patients, symptoms and severity of disease etc) and explain the specific genetic cause of the disease; explain the background to a suitable gene therapy – a technique that could be used for manipulation of the DNA or RNA as to partially or fully control the error – and describe the actual therapeutic agent which will be used and the clinical outcomes. You will be given guidance on how you may choose to structure your essay and explicit instructions on the required content and what diseases are appropriate (and which are not – e.g. most cancers).

If you think that a last-minute half-hearted effort will do (maybe you always breezed through exams before!) then you are likely to get a disappointing grade…but if you put in the effort and take this seriously, then a good or excellent grade is likely to be the result.

This essay counts for 30% of the final grade

Class Representatives

We value students’ opinions in regard to enhancing the quality of teaching and its delivery; therefore, in conjunction with the Students’ Association we support the Class Representative system.

In the School of Medicine, Medical Sciences & Nutrition we operate a system of course representatives, who are elected from within each course. Any student registered within a course that wishes to represent a given group of students can stand for election as a class representative. You will be informed when the elections for class representative will take place.

What will it involve?

It will involve speaking to your fellow students about the course you represent. This can include any comments that they may have. You will attend a Staff-Student Liaison Committee and you should represent the views and concerns of the students within this meeting. As a representative, you will also be able to contribute to the agenda. You will then feedback to the students after this meeting with any actions that are being taken.

Training

Training for class representatives will be run by the Students Association. Training will take place within each half-session. For more information about the Class representative system visit [www.ausa.org.uk](http://www.ausa.org.uk) or email the VP Education & Employability [vped@abdn.ac.uk](mailto:vped@abdn.ac.uk) . Class representatives are also eligible to undertake the STAR (Students Taking Active Roles) Award with further information about this co-curricular award being available at: [www.abdn.ac.uk/careers](http://www.abdn.ac.uk/careers).

Problems with Coursework

Staff are on your side!!! If students have difficulties with any part of the course that they cannot cope with, they should please please please notify the course coordinator immediately – who, contrary to how it may sometimes seem, genuinely wants you to get as high a mark as is possible – nobody *needs* to get a poor grade on this course! If the problem relates to the subject matter in general, advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact the medical sciences office, ([medsci@abdn.ac.uk](mailto:medsci@abdn.ac.uk)) (based in the Polwarth Building, Foresterhill) to ensure that the appropriate facilities have been made available. Otherwise, you are strongly encouraged to contact any of the following as you see appropriate:

* Course coordinator
* Course student representatives
* Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)
* Convenor of the Medical Sciences Staff/Student Liaison Committee (Professor Gordon McEwan)
* Personal Tutor

All staff are based at Foresterhill and we strongly encourage the use of email or telephone the Medical Sciences Office. You may have a wasted journey travelling to Foresterhill only to find staff unavailable.

Course Reading List

There is no single text that covers the contents of this course and, in this field, textbooks can go out of date fairly quickly. Most general biotechnology texts will provide relevant information. Some additional texts are also detailed below.

Lodish H et al., Molecular Cell Biology (MacMillan, Basingstoke 7th Ed) 2012 ISBN: 1464109818

Alberts et al., Molecular Biology of the Cell (Garland, 6th Ed) 2014 ISBN: 9780815344322

Brown T A, Gene Cloning and DNA analysis: An Introduction (Blackwell, 6th edition) 2010 ISBN: 978-1-4051-8173-0

Primrose & Twyman, Principles of Gene Manipulation and Genomics (Wiley-Blackwell, 7th Ed) 2006 ISBN: 978-1-4051-3544-3

Turner, McLennan, Bates & Whyte. Molecular Biology (Instant Notes) (Taylor & Francis, 3rd Ed) 2005. ISBN: 0415351677 (This contains very useful notes on techniques and is particularly useful as background reading for the cloning lab).

* The University Library has copies of all the books on the list.
* If buying any of these books, make sure you buy the most up to date version. Past editions of these books can substitute to some extent but be aware that as technology advances rapidly, outdated versions may give incomplete information.

*There are some special topics for which suitable chapters of an electronically-available textbook will be given. Specifically, Chapter 20 – Genome Defense:*

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There are any number of online resources available to explain CRISPR – a rapidly changing field for which any level of hyperbole is applicable – to suit all levels of expertise. These include:

* [What is Crispr Gene Editing? The Complete WIRED Guide | WIRED](https://www.wired.com/story/wired-guide-to-crispr/)
* [CRISPR 101 | The Simple Guide to Learning CRISPR (synthego.com)](https://www.synthego.com/resources/crispr-101-ebook)
* [Everything You Need to Know About CRISPR-Cas9 (synthego.com)](https://www.synthego.com/learn/crispr)

Lecture Synopsis

**Subject - Gene cloning**

**No of Lectures - 3**

**Lecturer - Prof C Munro**

These lectures give an account of the techniques employed in the manipulation of DNA and the cloning of specific DNA sequences and complement the Cloning practical. Topics to be covered include -

* Cutting and Joining DNA: restriction endonucleases, ligases, polymerases, gel electrophoresis
* Cloning vectors: plasmids and expression vectors
* Cloning: constructing gene/cDNA libraries
* Selection strategies: DNA homology, antibody screening, functional complementation

**Subject - Genomics**

**No of Lectures – 4**

**Lecturer – Dr M Gostic**

Genomics is a term that refers to the global analysis of an organism's gene function. The first step involves the large-scale application of gene cloning techniques. The aim of these lectures is to give an overview of techniques employed in genome projects: from the generation of the raw DNA sequence to the computational analysis of this sequence. Examples from human, *C. elegans* and *Drosophila* genome projects will be used to illustrate key experimental approaches. Topics to be covered will include:

* Genome sequencing strategies: the special problems created by genome projects; generating whole genome physical maps; clone-by-clone Vs shotgun assembly approaches
* Deciphering the genome: identifying protein coding genes; the combined use of experimental approaches such as computational gene finding and cDNA projects.
* Assigning function to genes: using sequence similarity as a tool to provide functional information.

**Subject - Gene expression analysis**

**No of Lectures - 3**

**Lecturer - Prof A MacKenzie**

How the one-dimensional information contained within the DNA of the genome is changed into a four-dimensional organism, remains one of the biggest questions in biology. This process starts with transcription. The instructions for where and when a gene is switched on are found in the regulatory regions (enhancers and promoters) that surround the gene and identification of these regions is critical. Once transcription has been initiated selected gene sequences are transcribed into mRNA that is then able to leave the nucleus. How a cell interacts with its environment and assumes a specific identity is reflected by the specific identity, amounts and timing of the expression of mRNA. These lectures explore current methods of identifying the promoter regions of genes and subsequently detecting specific mRNA species.

* Promoter analysis: bioinformatics approaches, reporter gene assays, transgenics
* Quantitative RNA detection Methods: Northern blots, RNAse protection Assay, rtPCR Differential display, macroarrays and microarrays
* Qualitative RNA detection Methods: In Situ Hybridisation; Sense and Antisense probes; Radioactive and non-radioactive RNA detection methods

**Subject – Exploring Genomic Manipulation: CRISPR/Cas9 and RNA Interference**

**No of Lectures – 1**

**Lecturer – Dr M Gostic**

This lecture delves into the advanced realms of molecular biology through an academic exploration of CRISPR-Cas9 and RNA interference (RNAi) techniques. Addressing their pivotal roles in genetic manipulation and analysis, the lectures aim to elucidate the mechanisms, applications, and implications of these tools.

Key Points:

* CRISPR-Cas9 Precision Gene Editing
* RNA Interference Mechanisms
* Genomic Decoding with CRISPR-Cas9 and RNAi
* Transcending Species Boundaries
* Ethical and Societal Considerations

**Subject – Stem Cells: Mechanisms and Applications**

**No of Lectures – 2, plus 1 workshop**

**Lecturer – Dr M Gostic**

This lecture series delves into stem cell science, exploring their biology and versatile roles. The lectures aim to convey a deep understanding of stem cell functions, developmental significance, and therapeutic applications.

Key Themes:

* Stem Cell Basics
* Tissue Regeneration and Cellular Reprogramming
* Microenvironment Influence
* Therapeutic Prospects
* Ethical Considerations and Future Pathways

**Subject - Foreign gene expression & protein purification**

**No of Lectures - 6**

**Lecturer - Prof J Barrow**

Recombinant DNA technology enables directed transfer and expression of DNA from one species to another. For some time now biologists have been able to harness this technology for the production of both pharmaceutically and scientifically important foreign proteins from a variety of species including man. The aim of these lectures is to explain the principles behind expression of foreign proteins. But in order to study the structure and function of a protein, it is necessary to purify the protein. This is true both for foreign proteins expressed in cells and for proteins derived from their natural source. These lectures will discuss the range of methods available for this purpose and the criteria for selecting particular methods.

* Why we purify proteins and what influences our choice of methods.
* The theory and practice behind commonly employed chromatographic methods.
* The use (and misuse) of protein fusions, such as His tags and maltose binding protein to facilitate protein purification.

**Subject - Antibodies as tools**

**No of Lectures - 2**

**Lecturer - Dr F Ward**

Antibodies are incredibly useful both in basic research, as diagnostics, and are increasingly being introduced as sophisticated therapeutics for a range of difficult to treat disorders including cancer.

* A basic overview of the adaptive immune response that underlies the production of antibodies will be introduced along with the principles of monoclonal antibody technology.
* Antibodies as research tools or in diagnosis: antibodies can be used in a number of techniques including ELISA, flow cytometry and immunocytochemistry. Even "everyday" tests such as the pregnancy test kit rely on antibody technology.
* Finally, while at a relatively early stage, antibody therapeutics are gaining market share year-on-year and several are now multi-billion pound blockbuster products. Notable examples of such therapies in cancer and autoimmune disease will be covered in detail.

**Subject – Protein Localisation**

**No of Lectures – 2**

**Lecturer - Prof B Müller**

Protein function is usually tightly linked to sub-cellular localisation i.e. growth factor receptors are targeted to the plasma membrane while transcription factors are localised in the nucleus. In some instances the sub-cellular localisation of a protein is subject to regulation i.e. upon activation Glucocorticoid receptors translocate from the cytoplasm to the nucleus where they act as transcription factors and activate gene expression. The aim of these lectures is to consider methods that can be used to determine the sub-cellular localisation of a specific protein.

* Cell extracts & fractionation techniques: Preparation of whole and fractionated cell extracts, including nuclei, cytosol, mitochondria and membrane fractions.
* Microscopy: use of tags, e.g. GFP; live cell imaging

**Subject - Protein:Protein interactions**

**No of Lectures – 2 plus 1 workshop**

**Lecturer – Dr B Hu**

Proteins often form protein complexes in order to carry out their particular function. The aim of these two lectures and workshop is to describe different experimental approaches to studying protein: protein interactions, using primary data to illustrate the advantages/disadvantages of each method.

* Yeast two hybrid: basic principle involved and use for identification of previously unknown protein: protein interactions
* Pull-down assays: using affinity purification of GST or His-tagged proteins to pull down interacting partners.
* Co-immunoprecipitation: the use of antibodies to one protein to pull down interacting proteins
* GFP fluorescence complementation (biFC): *in vivo* association of two non-fluorescent fragments followed by reconstitution of the fluorophore when two labelled proteins in a close proximity
* Fluorescence resonance energy transfer (FRET): reveals the relative proximity of the protein molecules in living cells based on fluorescence resonance energy transfer
* Proximity Ligation Assay (PLA)
* Demonstrate how to use AlphaFold to predict protein/protein interaction

**Subject - Protein: Nucleic Acid Interactions**

**No of Lectures - 2**

**Lecturer - Prof B Müller**

A subset of proteins within the cell play a crucial role in controlling gene expression by interacting with DNA or RNA, e.g. transcription or splicing factors, and a number of powerful techniques are available with which to analyse such protein: nucleic acid interactions. The aim of these lectures is to introduce you to some of these techniques and show you how to analyse the data that these methods can generate.

* Analysis of protein-nucleic acid interactions *in vitro*: EMSA (gel electrophoretic mobility shift assay)
* ChIP: chromatin immunoprecipitation
* Chip-Seq: Genome wide analysis of protein-DNA interaction

**Subject – Peptide therapeutics**

**No of Lectures - 1**

**Lecturer – Dr S Dall’Angelo**

Since the synthesis of insulin in 1921, the first therapeutic peptide, almost 100 peptide drugs have reached the market. Nowadays, peptides can be used to treat a wide range of diseases, including diabetes, cancer, osteoporosis, multiple sclerosis, and chronic pain.  We will explore early efforts related to human hormones, more modern medicinal chemistry and rational design strategies, and drugs derived from nature. Eventually, we will tackle the challenges that pharmaceutical research needs to overcome to allow peptide-based therapeutics to reach their full potential.

**Subject – Proteomics**

**No of Lectures - 2**

**Lecturer - Dr D Stead**

Proteomics is a term that refers to the analysis of the proteins expressed by an organism, tissue or cell (the proteome). Because of the high complexity and wide dynamic range within a proteome, large-scale proteomic studies tend to provide information about the more abundant proteins. The aim of these lectures is to provide an overview of the main techniques used in proteomics and the strategies for their application. Topics to be covered will include:

* Protein identification: Peptide mass fingerprinting and tandem mass spectrometry.
* Quantification: 2-D gel electrophoresis and mass spectrometric techniques.
* Post-translational modifications: How they may be detected and characterised.

**Subject – Synthetic biology in Drug Discovery**

**No of Lectures - 2**

**Lecturer – Dr W Houssen**

Synthetic biology brings together disciplines like chemistry, biology, computing and engineering. It is broadly defined as the design and construction of novel artificial biological pathways, organisms or devices; or to the redesign of existing natural biological systems for the production of useful products. In this lecture, we will learn more about synthetic biology and how it could be used to make in vivo production platform or cell factories for new therapeutics.

**Subject – Target selection and validation**

**No of Lectures - 2**

**Lecturer – Dr I Greig**

Only a small proportion of the human genome encodes for proteins which are involved in disease-related processes; only a small proportion of the human genome encodes for proteins which can be modulated by a small molecule drug. The overlap between these – drug targets - is even smaller. So, what makes a good drug target and why can we only modulate some targets and not others?

* What is a drug target?
* Why are some targets easier than others?
* What is druggability?
* How do we prove that a target is involved in a disease?

Practical/Lab/Tutorial Work

**SUMMARY OF PRACTICALS:**

There will be two practicals, a “wet” laboratory Cloning Practical and a computer simulation on Protein Purification. The Cloning Practical involves a continuous experiment which runs over four two-hour sessions. Attendance at all of these sessions is compulsory and is monitored.

**1. CLONING PRACTICAL:**

This practical will be assessed by a final report

Continuous Assessment:

**ASSIGNMENT CONTRIBUTION TO FINAL MARK**

Online submission of final report 25%

Cloning and propagation of restriction fragments in Escherichia coli using the plasmid pBR322.

The main aim of this practical is to teach you some of the basic methods that are central to most gene cloning strategies. A summary of the planned work is shown below and the complete practical manual is available on the course MyAberdeen site; a hard copy of the practical manual will be given out at the first practical session. You are encouraged to read each session’s practical work in advance of the practical so that you can work more effectively.

1. You will use the restriction enzymes EcoRI and BamHI to digest DNA from both phage λ (lambda), to make inserts, and from the vector pBR322.
2. The products of digestion will be analysed using agarose gel electrophoresis.
3. After cleavage, the restriction enzymes will be inactivated by heat treatment; the DNA fragments will be mixed and then ligated together using T4 DNA ligase.
4. The sequence specificity of the ends generated in the two populations of DNA fragments (lambda and pBR322) by BamHI and EcoRI allows only those DNA fragments to be ligated to form circles which have one end terminated by a BamHI cleavage site and the other terminated by an EcoRI cleavage site (see Fig.1). Many of the lambda DNA sequences have such a structure and can therefore combine with BamHI/EcoRI-cut pBR322 to form a mixture of circular recombinant DNA molecules of the type indicated.
5. These circular forms are able effectively to transform competent bacterial cells and propagate within them.
6. Cells that acquire plasmids can be selected on the basis of their resistance to ampicillin, resulting from the presence of the AmpR gene located on fragment 1 of pBR322. Since, on average, cells are unlikely to receive more than one recombinant DNA molecule, DNA plasmids in the mixture are "cloned" in individual cells which are separated by plating on nutrient medium containing ampicillin.
7. Those bacterial colonies containing recombinant plasmids which have a target DNA segment inserted between the EcoRI and BamHI cleavage sites of pBR322 are identified by their sensitivity to tetracycline, since the TetR gene of pBR322 is interrupted and inactivated by insertion of DNA at this position.
8. Finally, you will investigate the structure of the recombinant plasmid DNA's isolated from three individual transformed clones. Restriction of a recombinant plasmid DNA with EcoRI and BamHI removes the lambda DNA insert from the plasmid, allowing the size of the insert to be determined by agarose gel electrophoresis. Further digests will confirm the identity of the cloned fragments.

**2. PROTEIN PURIFICATION COMPUTER AIDED LEARNING PRACTICAL:**

The aim of this practical is to enable you to apply your theoretical knowledge of protein structure and properties to explore various scenarios for purifying proteins. The programme allows you to choose the most effective methods from a number of laboratory procedures and gives you “on screen” results of your chosen method. In this manner you can explore different scenarios much more quickly than would be possible in the laboratory.

This practical will be assessed by a test that will be available on MyAberdeen.

**ASSIGNMENT CONTRIBUTION TO FINAL MARK**

Online CAL protein purification assessment 15%

SM3001 Tutorials

Tutorial work is not assessed but attendance is compulsory and is monitored (details regarding groups will be given out nearer the time the tutorial is to be held). It is essential that you prepare for the tutorials by reading the material provided so that you come to each tutorial prepared to answer the accompanying questions. The material for tutorial 2 is available on the SM3001 course MyAberdeen site.

**Tutorial Topic**

Tutorial 1 Making an expression plasmid for growth hormone

Tutorial 2 Analysing primary data from a research paper

The first tutorial is a theoretical exercise in making a plasmid to allow expression of human growth hormone. This will reinforce the first cloning lectures and, as groups will be split as far as possible into similar intended degrees, this tutorial will allow students to get to know others doing the same degree.

For the second tutorial, you will be provided with a single figure from a research paper. You will have to prepare the presentation of this figure, focusing on the research the methods used and a critical evaluation of the data.

SM3001 Tutorial 1: Making an expression plasmid for growth hormone.

**Introduction**

Growth hormone is produced by the pituitary gland at the base of the brain and defects in its production or secretion can cause dwarfism. Children who show growth deficiencies can sometimes be treated with injections of growth hormone. Originally, the growth hormone used was extracted and purified from human cadaver pituitary tissue. However, due to worries about transmission of diseases such as CJD (prion disease), the growth hormone is now produced recombinantly from *E. coli* that have been genetically engineered to make the protein.

A typical method of making the expression construct would start with extracting RNA from the pituitary tissue and reverse transcribing it to produce cDNA. This process gives a population of cDNAs, each encoding a single protein expressed in the pituitary. You would then need to “find” the cDNA that encodes growth hormone and insert it into a suitable vector for expression in *E. coli*. You could do this by using specific primers to amplify up the growth hormone cDNA in a PCR reaction.

In this tutorial you will work in groups to devise a strategy to amplify up DNA encoding human growth hormone for subsequent insertion into the expression vector.

**Designing the primers**

1. First think about how, once you’ve amplified up your DNA, you would then insert it into the vector. HINT: would restriction sites at the ends of the amplified DNA help?
2. Can you identify in the sequence below the start (ATG) and stop (TAG) sites for translation of the protein? What region of the sequence below would you have to amplify in order to produce growth hormone protein?
3. Can you identify which restriction endonucleases cut at the sequences highlighted below?
4. With this in mind, which restriction sites would be most helpful if you could incorporate them into your amplified sequence? HINT: check out the multiple cloning site (MCS) of the vector you want to put the amplified DNA into (see below).
5. How can you incorporate these restriction sites into your amplified DNA?
6. Design your primers, remembering you need a forward and a reverse primer.

**Sequence of growth hormone DNA**

1 agcgtcccaa ggcccaactc cccgaaccac tcagggtcct gtggacagct cacctagctg

61 caatggctac aggctcccgg acgtccctgc tcctggcttt tggcctgctc tgcctgccct

121 ggcttcaaga gggcagtgcc ttcccaacca ttcccttatc caggcttttt gacaacgcta

181 tgctccgcgc ccatcgtctg cac***cagctg***g cctttgacac ctaccaggag tttgaagaag

241 cctatatccc aaaggaacag aagtattcat tcctgcagaa cccccagacc tccctctgtt

301 tctcagagtc tattccgaca ccctccaaca gggaggaaac acaacagaaa tccaacctag

361 agctgctccg catctccctg ctgctcatcc agtcgtggct ggagcccgtg cagttcctca

421 ggagtgtctt cgccaacagc ctggtgtacg gcgcctctga cagcaacgtc tatgacctcc

481 taaaggacct agaggaaggc atccaaacgc tgatggggag gctggaagat ggcagccccc

541 ggactgggc***a gatct***tcaag cagacctaca gcaagttcga cacaaactca cacaacgatg

601 acgcactact caagaactac gggctgctct actgcttcag gaaggacatg gacaaggtcg

661 agacattcct gcgcatcgtg cagtgccgct ctgtggaggg ***cagctg***tggc ttctagctg***c***

721 ***ccggg***tggca tccctgtgac ccctccccag tgcctctcct ggccctggaa gttgccactc

781 cagtgcccac cagccttgtc ctaataaaat taagttgcat ca

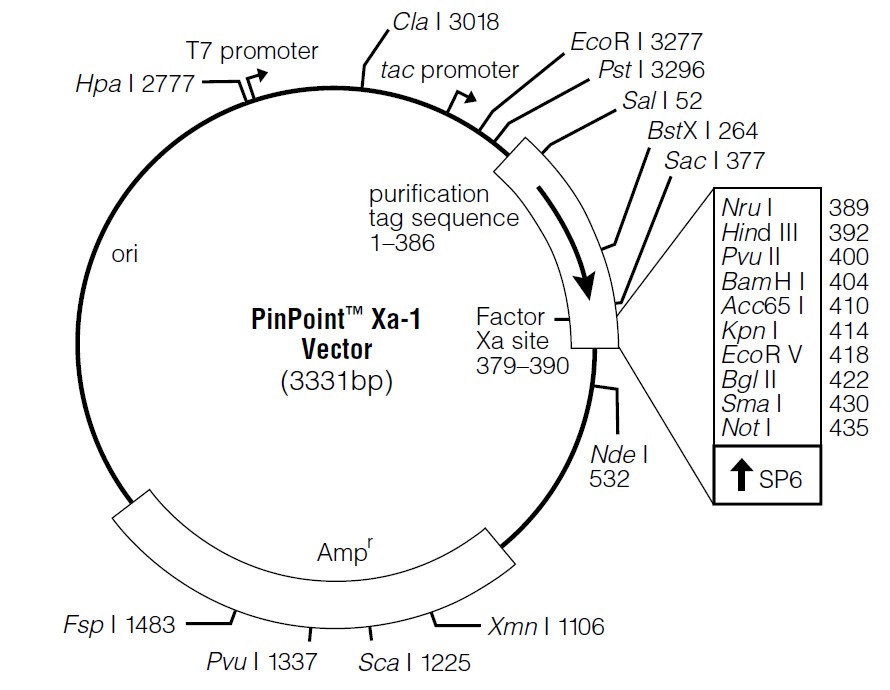
Translation starts at the first ATG and finishes with a TAG stop codon. The hGH protein is 217 amino acids in length. Highlighted in bold, italics in the sequence above are known endonuclease restriction sites

Sequences recognised by selected restriction endonucleases (the enzyme cut site is denoted by / ):

NruI (tcg/cga), Hind III (a/agctt), Pvu II(cag/ctg), BamH I (g/gatcc), Acc65 I (g/gtacc), Kpn I (ggtac/c), EcoR V (gat/atc), Bgl II (a/gatct), Sma I (ccc/ggg), Not I (gc/ggccgc)

**Map of expression vector:**

The MCS is between 389 and 452



SM3001 Tutorial 2: Analysing primary data from a research paper

Learning outcome: Analyse data from a research paper using examples provided in the tutorial exercise and present to the tutorial group.

In this tutorial you will work in small groups to analyse figure panels from research papers. You are expected to gain an understanding of the questions asked and of the approaches used to answer these questions. You will have an opportunity to discuss your analysis with the rest of the class.

Your need to address and answer the following questions:

* **What is the purpose of the experiment?** What is the question the authors ask? Why are they interested?
* **What is/are the methods used?**  You will need to prepare an explanation of the methods used.)
* **What is/are the finding(s)?** Use the figure to explain how the authors arrive at their conclusions.

You should also consider the following questions:

* **Are you convinced by the experiment?** Are essential controls missing?
* **What other experiments could/should be done?** What other experiments could you do to prove the point made?

How can you prepare this?

* Start with the figure and figure legend. Dissect the figure into its different parts. Ask yourself the following questions: What is the role of each part? Does it explain a method? Does it show an experiment/data?
* Identify and research the methods used. Check your lecture notes, the research article (relevant part of methods and results section) and other sources for information. Google it.
* Critically look at each part of the figure, make sure you know what is going on and draw your own conclusions from the data. In case data is shown as measurements only, make sure you know how the numbers are arrived at. Ask yourself whether any controls are missing.

University Policies

Students are asked to make themselves familiar with the information on key education policies, available [here](https://www.abdn.ac.uk/staffnet/teaching/key-education-policies-for-students-11809.php). These policies are relevant to all students and will be useful to you throughout your studies.  They contain important information and address issues such as what to do if you are absent, how to raise an appeal or a complaint and how the University will calculate your degree outcome.

These University wide education policies should be read in conjunction with this programme and/or course handbook, in which School specific policies are detailed. These policies are effective immediately, for the 2023/24 academic year. Further information can be found on the [University’s Infohub webpage](https://www.abdn.ac.uk/students/) or by visiting the Infohub.

The information included in the institutional area for 2023-24 includes the following:

* Assessment
* Feedback
* Academic Integrity
* Absence
* Student Monitoring/ Class Certificates
* Late Submission of Work
* Student Discipline
* The co-curriculum
* Student Learning Service (SLS)
* Professional and Academic Development
* Graduate Attributes
* Email Use
* MyAberdeen
* Appeals and Complaints

Where to Find the Following Information:

C6/C7- University of Aberdeen Homepage > Students > Academic Life > Monitoring and Progress > Student Monitoring (C6 & C7)

https://www.abdn.ac.uk/students/academic-life/student-monitoring.php#panel5179

Absences- To report absences you should use the absence reporting system tool on Student Hub. Once you have successfully completed and sent the absence form you will get an email that your absence request has been accepted. The link below can be used to log onto the Student Hub Website and from there you can record any absences you may have.

[Log In - Student Hub (ahttps://www.abdn.ac.uk/studenthub/loginbdn.ac.uk)](https://www.abdn.ac.uk/studenthub/login)

Submitting an Appeal- University of Aberdeen Homepage > Students > Academic Life > Appeals and Complaints

https://www.abdn.ac.uk/students/academic-life/appeals-complaints-3380.php#panel2109

Academic Language & Skills support

For students whose first language is not English, the Language Centre offers support with Academic Writing and Communication Skills.

Academic Writing

* Responding to a writing task: Focusing on the question
* Organising your writing: within & between paragraphs
* Using sources to support your writing (including writing in your own words, and

citing & referencing conventions)

* Using academic language
* Critical Thinking
* Proofreading & Editing

Academic Communication Skills

* Developing skills for effective communication in an academic context
* Promoting critical thinking and evaluation
* Giving opportunities to develop confidence in communicating in English
* Developing interactive competence: contributing and responding to seminar discussions
* Useful vocabulary and expressions for taking part in discussions

More information and how to book a place can be found here

Medical Sciences Common Grading Scale

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Grade | Grade Point | % Mark | Category | Honours Class | Description |
| A1 | 22 | 90-100 | Excellent | First | • Outstanding ability and critical thought • Evidence of extensive reading • Superior understanding •The best performance that can be expected from a student at this level |
|  |
| A2 | 21 | 85-89 |  |
|  |
| A3 | 20 | 80-84 |  |
|  |
| A4 | 19 | 75-79 |  |
|  |
| A5 | 18 | 70-74 |  |
|  |
| B1 | 17 | 67-69 | Very Good | Upper Second | • Able to argue logically and organise answers well  • Shows a thorough grasp of concepts  • Good use of examples to illustrate points and justify arguments  • Evidence of reading and wide appreciation of subject |  |
|  |
| B2 | 16 | 64-66 |  |
|  |
| B3 | 15 | 60-63 |  |
|  |
| C1 | 14 | 57-59 | Good | Lower Second | • Repetition of lecture notes without evidence of further appreciation of subject • Lacking illustrative examples and originality • Basic level of understanding |  |
|  |
| C2 | 13 | 54-56 |  |
|  |
| C3 | 12 | 50-53 |  |
|  |
| D1 | 11 | 47-49 | Pass | Third | • Limited ability to argue logically and organise answers • Failure to develop or illustrate points • The minimum level of performance required for a student to be awarded a pass |  |
|  |
| D2 | 10 | 44-46 |  |
|  |
| D3 | 9 | 40-43 |  |
|  |
| E1 | 8 | 37-39 | Fail | Fail | • Weak presentation • Tendency to irrelevance • Some attempt at an answer but seriously lacking in content and/or ability to organise thoughts |  |
|  |
| E2 | 7 | 34-36 |  |
|  |
| E3 | 6 | 30-33 |  |
|  |
| F1 | 5 | 26-29 | Clear Fail | Not used for Honours | • Contains major errors or misconceptions • Poor presentation |  |
|  |
| F2 | 4 | 21-25 |  |
|  |
| F3 | 3 | 16-20 |  |
|  |
| G1 | 2 | 11-15 | Clear Fail/Abysmal |  | • Token or no submission |  |
|  |
| G2 | 1 | 1-10 |  |
|  |
| G3 | 0 | 0 |  |
|  |

Course Timetable SM3001: 2023-2024

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Date | Time | Place | Subject | Session | Staff |
| Week 8 | | | | | |
| Mon 18 Sep |  |  |  |  |  |
| Tue 19 Sep |  |  |  |  |  |
| Wed 20 Sep | 11:00-12:00 | NK14 | 8.1 Course Introduction | Lecture | Dr I Greig / Dr M. Gostic |
| 12:00-13:00 | NK14 | 8.2 Gene cloning (1) | Lecture | Prof C Munro |
| Thu 21 Sep | 09:00-13:00 | STH 1.007 | Cloning Laboratory (Part 1) | Practical | Prof C Munro |
| Fri 22 Sep | 10:00-12:00 | Auris LT | 8.3 Genomics (1-2) | Lecture | Dr M Gostic |
| Week 9 | | | | | |
| Mon 25 Sep | 10:00-12:00 | MT2 | 9.1 Genomics (3-4) | Lecture | Dr M Gostic |
| Tue 26 Sep |  |  |  |  |  |
| Wed 27 Sep | 11:00-13:00 | Auris LT | 9.2 Gene Cloning (2-3) | Lecture | Prof C Munro |
| Thu 28 Sep | 09:00-13:00 | STH 1.007 | Cloning Laboratory (Part 2) | Practical | Prof C Munro |
| Fri 29 Sep | 11:00-13:00 | Taylor C16 | Tutorial 1/Group 1 | Tutorial | Dr S Miller |
| 11:00-13:00 | Zoology ZB16 | Tutorial 1/Group 2 | Tutorial | Prof J Barrow |
| 11:00-13:00 | Zoology ZB17 | Tutorial 1/Group 3 | Tutorial | Prof A MacKenzie |
| Week 10 | | | | | |
| Mon 2 Oct | 10:00-11:00 | Auris LT | 10.1 Gene Expression (1) | Lecture | Prof A MacKenzie |
| Tue 3 Oct |  |  |  |  |  |
| Wed 4 Oct | 12:00-13:00 | Auris LT | 10.2 Protein-protein Interactions (1) | Lecture | Dr B Hu |
| Thu 5 Oct | 09:00-13:00 | STH 1.007 | Cloning Laboratory (Part 3) | Practical | Prof C Munro |
| Fri 6 Oct | 10:00-12:00 | Auris LT | 10.3 Guidance for Gene Therapy Essay | Workshop | Dr I Greig |
| Week 11 | | | | | |
| Mon 9 Oct | 10:00-11:00 | Auris LT | 11.1 Protein-protein Interactions (2) | Lecture | Dr B Hu |
| Tue 10 Oct |  |  |  |  |  |
| Wed 11 Oct | 12:00-13:00 | Auris LT | 11.2 Gene Expression (2) | Lecture | Prof A MacKenzie |
| Thu 12 Oct | 09:00-13:00 | STH 2.001 | Cloning Laboratory (Part 4) | Practical | Prof C Munro |
| Fri 13 Oct | 10:00-11:00 | St Marys 105 | 11.3 Gene Expression (3) | Lecture | Prof A MacKenzie |
| Week 12 | | | | | |
| Mon 16 Oct | 10:00-11:00 | Auris LT | 12.1 siRNA/CRISPR | Lecture | Dr M Gostic |
| Tue 17 Oct |  |  |  |  |  |
| Wed 18 Oct | 12:00-13:00 | Auris LT | 12.2 Protein Expression (1) | Lecture | Prof J Barrow |
| Thu 19 Oct | 09:00-13:00 | STH 1.007 | Cloning Laboratory (Part 5) | Practical | Prof C Munro |
| Fri 20 Oct | 10:00-11:00 | St Marys 105 | 12.3 Protein Expression (2) | Lecture | Prof J Barrow |
| Week 13 | | | | | |
| Mon 23 Oct | 09:00-11:00 | Auris LT | 13.1 Antibodies as tools (1-2) | Lecture | Dr F Ward |
| Tue 24 Oct |  |  |  |  |  |
| Wed 25 Oct | 12:00-13:00 | Auris LT | 13.2 Protein Purification (1) | Lecture | Prof J Barrow |
| Thu 26 Oct | 09:00-13:00 | STH 1.007 | Cloning Laboratory (Part 6) | Practical | Prof C Munro |
| Fri 27 Oct | 10:00-11:00 | St Marys 105 | 13.3 Protein Purification (2) | Lecture | Prof J Barrow |
| Week 14 | | | | | |
| Mon 30 Oct | 09:00-11:00 | Auris LT | 14.1 Protein Purification (3-4) | Lecture | Prof J Barrow |
| Tue 31 Oct | 23:59 |  | Deadline 1: Gene Therapy Essay |  |  |
| Wed 1 Nov | 12:00-13:00 | Auris LT | 14.2 Protein Localisation (1) | Lecture | Prof B Müller |
| Thu 2 Nov | 09:00-13:00 | STH 1.007 | Cloning Laboratory (Part 7) | Practical | Prof C Munro |
| Fri 3 Nov | 10:00-11:00 | St Marys 105 | 14.3 Protein Localisation (2) | Lecture | Prof B Müller |
| Week 15 | | | | | |
| Mon 6 Nov | 10:00-12:00 | Kings KCF7 | 15.1 Stem Cell Technologies (1-2) | Lecture | Dr M Gostic |
| Tue 7 Nov |  |  |  |  |  |
| Wed 8 Nov | 11:00-13:00 | Auris LT | 15.2 Peptide Therapeutics | Workshop | Dr S Dall’Angelo |
| Thu 9 Nov | 10:00-11:00 | Kings KCG7 | 15.3 Target Validation 1 | Lecture | Dr I Greig |
| Fri 10 Nov | 10:00-11:00 | St Marys 105 | 15.4 Stem Cell Workshop | Lecture | Dr M Gostic |
| 23:59 |  | Deadline 2: Cloning Laboratory report |  |  |
| Week 16 | | | | | |
| Mon 13 Nov | 09:00-11:00 | Auris LT | 16.1 Data analysis workshop | Workshop | Prof B Müller |
| Tue 14 Nov |  |  |  |  |  |
| Wed 15 Nov | 12:00-13:00 | Auris LT | 16.2 Proteomics | Lecture | Dr D Stead |
| Thu 16 Nov | 10:00-11:00 | Kings KCG7 | 16.3 Proteomics workshop | Lecture | Dr D Stead |
| Fri 17 Nov | 11:00-13:00 | Taylor C16 | Tutorial 2/Group 1 | Tutorial | Dr S Miller |
| 11:00-13:00 | Zoology ZB16 | Tutorial 2/Group 2 | Tutorial | Prof J Barrow |
| 11:00-13:00 | Zoology ZB17 | Tutorial 2/Group 3 | Tutorial | Prof A MacKenzie |
| Week 17 | | | | | |
| Mon 20 Nov | 10:00-11:00 | Auris LT | 17.1 Target Validation 2 | Lecture | Dr I Greig |
| Tue 21 Nov |  |  |  |  |  |
| Wed 22 Nov |  |  |  |  |  |
| Thu 23 Nov | 10:00-13:00 | FN112 | 17.2 CAL Protein Purification Workshop | Practical | Dr S Dall-Angelo |
| Fri 24 Nov | 10:00-12:00 | Kings KCG7 | 17.3 Synthetic Biology | Lecture | Dr W Houssen |
| Fri 24 Nov | 23:59 |  | Deadline 3: Protein separation quiz |  |  |
| Week 18 | | | | | |
| Mon 27 Nov |  |  |  |  |  |
| Tue 28 Nov |  |  |  |  |  |
| Wed 29 Nov |  |  |  |  |  |
| Thu 30 Nov |  |  |  |  |  |
| Fri 1 Dec | 12:00-14:00 | Comp S81 | Exam – Group 1 |  |  |
| 12:00-14:00 | Comp S84 | Exam – Group 2 |  |  |

Venues

|  |
| --- |
| Auris LT - Cruickshank – head up the lane, past the greenhouses, towards the main building, instead turn left and it is there up a couple of steps behind a hand rail – looks unlikely but that’s it…quite nice inside |
| STH – that nice new building |
| Comp S81/S84 – computer room in Edward Wright Building |
| KCF7, KCG7 - Kings College |
| C16 - Taylor Building |
| G3 - St Marys |
| NK1, NK14 - New King’s |
| MR252, MR265 - MacRobert Building |
| MT2 - Meston Building – I know, weird choice. |
| ZB13, ZB14, ZG11 - Zoology Building |

Campus Maps - Foresterhill



Polwarth Floor Plans

Diagram, schematic

Description automatically generated

Diagram

Description automatically generated

Diagram

Description automatically generated