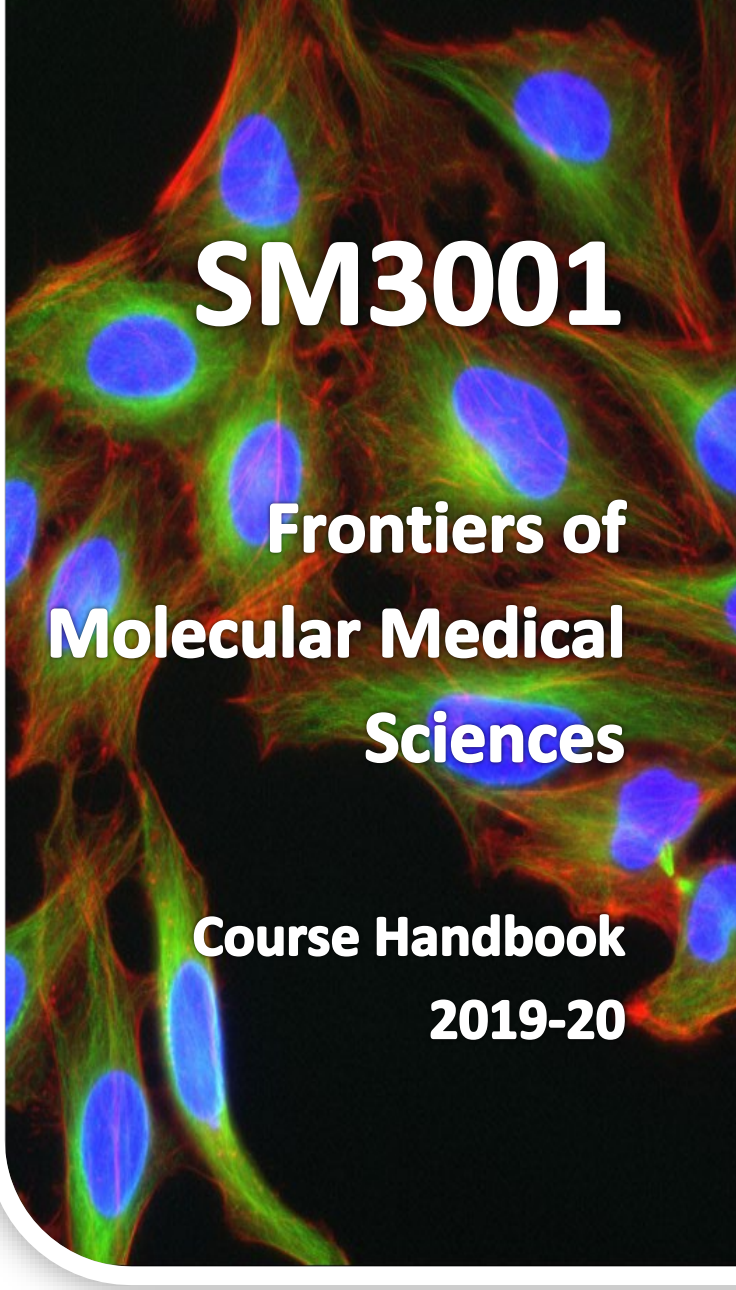
School Of Medicine, Medical Sciences & Nutrition



SM3001

Frontiers of Molecular Medical Sciences

Course Handbook
2019-20

UNIVERSITY OF ABERDEEN

Contents

Cover image:
Confocal micrograph of fluorescently labelled HeLa cells.
Nuclei are labelled in blue, tubulin in green and actin fibres in red.

Courtesy of:
Kevin Mackenzie
Microscopy and Histology Core Facility
Institute of Medical Sciences
University of Aberdeen
http://www.abdn.ac.uk/ims/microscopy-histology

Course Summary

The “Frontiers of Molecular Medical Sciences" course, SM3001, runs during the first half-session. The modern biologist, if they wish to completely understand a biological process, must 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 drawing on the full range of techniques currently employed in biological research. It will provide students with core knowledge facilitating effective study of all fields of modern biology.

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 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.

Some lectures in this course, particularly those that span 2 hours, will be interactive using group discussion and PRS to aid analysis of primary research data. The tutorials enable further group work and allow discussion of a topic in an informal setting. The laboratory class gives you practical experience of some of the basic cloning techniques that are the basis of many research papers. The computer class (laboratory simulation) allows you to generate and analyse a large body of data that would be impossible to produce in the timescale of this course. It also provides an opportunity to improve your computer skills.

Course Aims & Learning Outcomes

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

- Describe the basic ‘tools’ and techniques used in molecular biology, such as enzymes, vectors, recombinant DNA methods, gene cloning, PCR etc;
- Describe techniques used for gene mapping to identify the basis of a given mutant phenotype;
- Describe computer techniques used to handle the wealth of nucleic acid and protein sequence data that is becoming available;
- Describe RNA structure, synthesis, degradation, isolation and characterisation techniques;
- Describe techniques that can be used to study (a) sub-cellular localisation of proteins and (b) global patterns of protein expression in different tissues and cell types;
- Describe techniques to analyse gene function. This to include classical genetic analysis, using mutants as a basis for cloning, sequencing and characterising a wild type gene, together with various genetic screening methods;

- Describe methods to obtain function information about a gene from a knowledge of only the gene sequence;
- 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;

Course Teaching Staff

Course Co-ordinator(s):

Dr Iain Greig (**i.greig@abdn.ac.uk**)

Teaching Staff:

Dr John Barrow (**j.barrow@abdn.ac.uk**)
Prof Al Brown (**al.brown@abdn.ac.uk**)
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Dr David Stead (**d.stead@abdn.ac.uk**)
Dr Frank Ward (**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 of continuous assessment (30%) and the end of course written exam (70%).

CONTINUOUS ASSESSMENT. This comprises the following assignments -

	ASSIGNMENT	VALUE OF FINAL MARK
1	DNA cloning practical lab report	25%
2	CAL protein purification test	5%

The cloning laboratory lab report will be submitted through MyAberdeen. A template for the lab report is provided in MyAberdeen and for illustration is also included in the Cloning Laboratory Practical Manual. Instructions for preparation of the report, details on the submission process and how the report will be assessed will be provided.

The CAL protein purification test is an on-line test that will be available after the practical has taken place on MyAberdeen.

WRITTEN EXAMINATIONS (70% of total):

This will be of three hours duration and will be held in the December diet of exams. The paper comprises essay-style questions. Past papers will be available on the course MyAberdeen site. Questions may be based on any part of the course. The re-sit examination will be based on the written paper as above and the previous continuous assessment marks achieved during the course.

Examination results: The results will be posted on the student portals as soon as possible (approximately 3 weeks) after the examination. The criteria used in marking examination questions are given later in the manual. Similar considerations apply to marking your other assessed written work.

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** or email the VP Education & Employability **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**.

Problems with Coursework

If students have difficulties with any part of the course that they cannot cope with alone they should notify the course coordinator immediately. If the problem relates to the subject matter general advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact Mrs Jenna Reynolds (**medsci@abdn.ac.uk**) in the School Office (based in the IMS, Foresterhill), or Mrs Sheila Jones (**s.jones@abdn.ac.uk**) in the Old Aberdeen office associated with the teaching laboratories, 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 student representatives
- Course co-ordinator

- Convenor of the Medical Sciences Staff/Student Liaison Committee (Prof Gordon McEwan)
- Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)

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.

If a course has been completed and students are no longer on campus (i.e work from second semester during the summer vacation), coursework will be kept until the end of Freshers' Week, during the new academic year. After that point, unclaimed student work will be securely destroyed.

Course Reading List

There is no single text that covers the contents of this course. 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).

Notes:

- 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.

Lecture Synopsis

Subject - Gene cloning
No of Lectures - 4
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 – 3
Lecturer - Prof B Connolly

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 - 4
Lecturer - Dr 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 - Functional Genomics:

No of Lectures – 2
Lecturer – Prof S Spanò

Classical genetic analysis in both microorganisms and higher eukaryotes has typically started with the isolation of a mutant with a given phenotype, on the basis of which the wild-type gene can be cloned, sequenced and characterised. However, we now know the complete (or nearly complete) gene complement for a variety of organisms; although the function of most of these genes is not known. Gene function can be studied by observing the effect of altering the activity of a given gene on an organism's phenotype. These lectures will introduce the concept of forward genetics to gene cloning, and go on to describe reverse genetics strategies, using examples from several model organisms.

- Forward genetics: from mutant to cloned gene
- Reverse genetics: RNA interference in *C. elegans*, Drosophila and mammalian cells, CRISPR/Cas9 genome engineering
- Transgenics: creation of knock-out mice

Subject - Foreign gene expression & protein purification

No of Lectures - 6
Lecturer - Dr 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 (& revision session)
No of Lectures - 4
Lecturer - Dr 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 – 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 - Protein:Protein interactions

No of Lectures - 4
Lecturer - Prof K I J Shennan

Proteins often form protein complexes in order to carry out their particular function. The aim of these lectures 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

Subject - Protein: Nucleic Acid Interactions (&revision session)
No of Lectures - 4
Lecturer - Dr 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

Practical/Lab/Tutorial Work

SUMMARY OF PRACTICALS:

There will be two assessed practicals, a "wet" laboratory Cloning Practical and a computer simulation on Protein Purification. The Cloning Practical involves a continuous experiment which runs over seven sessions in the first half of the course (including a tutorial in session 6). Attendance at all of these sessions is compulsory and is monitored.

1. CLONING PRACTICAL:

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.

A template for word processing your report is available on the SM3001 MyAberdeen site.

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.

Each student will attend one timetabled 3 hour session. This practical will be assessed by a test that will be available on MyAberdeen.

Continuous Assessment:

ASSIGNMENT	**CONTRIBUTION TO FINAL MARK**
1 DNA cloning practical report	25%
2 CAL protein purification report	5%

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 you 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
```

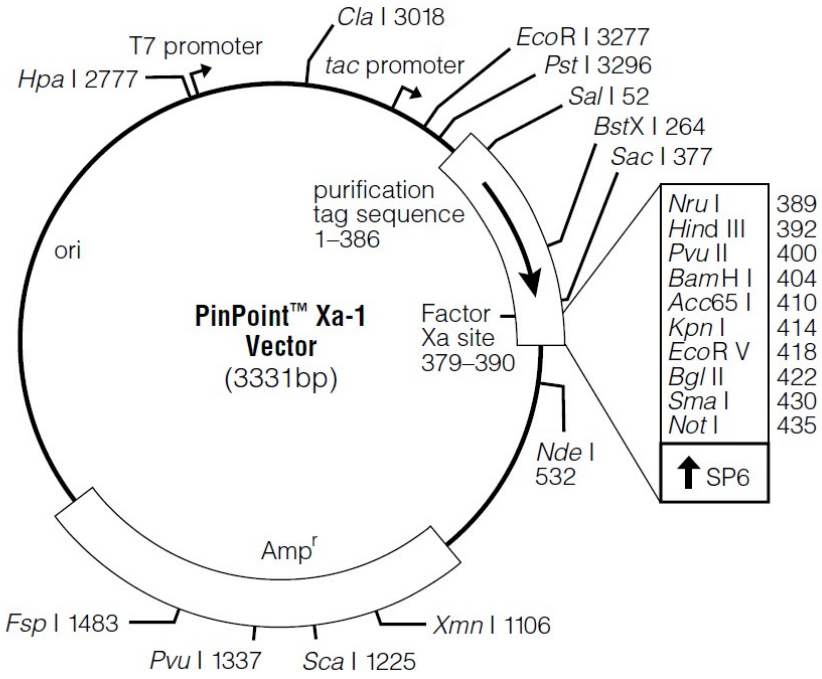
Translation starts at the first ATG and finishes with a TAG stop codon. The hGH protein is 217 amino acids in length. Highlighted in bold, italics in the sequence above are known endonuclease restriction sites

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 institutional policies which been made available within MyAberdeen (**https://abdn.blackboard.com/bbcswebdav/institution/Policies**). 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 indicate how seriously the University takes your feedback.

These institutional policies should be read in conjunction with this programme and/or course handbook, in which School and College specific policies are detailed. Further information can be found on the **University[1]s Infohub webpage** or by visiting the Infohub.

The information included in the institutional area for 2019/20 includes the following:

- Absence
- Appeals & Complaints
- Student Discipline
- Class Certificates
- MyAberdeen
- Originality Checking
- Feedback
- Communication
- Graduate Attributes
- The Co-Curriculum

Medical Sciences Common Grading Scale

Grade	Grade Point	Category	Honours Class	Description
A1	22	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			
A3	20			
A4	19			
A5	18			
B1	17	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			
B3	15			
C1	14	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			
C3	12			
D1	11	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			
D3	9			
E1	8	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			
E3	6			
F1	5	Clear Fail	Not used for Honours	• Contains major errors or misconceptions • Poor presentation
F2	4			
F3	3			
G1	2	Clear Fail/ Abysmal	-	• Token or no submission
G2	1			
G3	0			

Course Timetable SM3001: 2019-2020

Date	Time	Place	Subject	Session	Staff
Week 7					
Mon 9 Sep					
Tue 10 Sep					
Wed 11 Sep	11:00-12:00	NK14	Course Introduction	Lecture	Dr I. Greig
	12:00-13:00	NK14	Gene cloning (1)	Lecture	Dr J Holland
Thu 12 Sep	09:00-13:00	ZB13/14	Cloning Laboratory (Part 1)	Practical	Dr J Holland
Fri 13 Sep	10:00-11:00	G3	Gene cloning (2)	Lecture	Dr J Holland
	11:00-12:00	G3	Gene cloning (3)	Lecture	Dr J Holland
Week 8					
Mon 16 Sep	10:00-11:00	FN116	Gene cloning (4)	Lecture	Dr J Holland
Tue 17 Sep					
Wed 18 Sep	11:00-12:00	105 ST Marys	Genomics (1)	Lecture	Prof B Connolly
	12:00-13:00	NK14	Genomics (2)	Lecture	Prof B Connolly
Thu 19 Sep	09:00-13:00	ZB13/14	Cloning Laboratory (Part 2)	Practical	Dr J Holland
Fri 20 Sep	10:00-11:00	G3	Genomics (3)	Lecture	Prof B Connolly
	11:00-13:00	MR265	Tutorial 1/Group 1	Tutorial	Dr S Miller
	11:00-13:00	MR252	Tutorial 1/Group 2	Tutorial	Dr F Ward
	11:00-13:00	C16	Tutorial 1/Group 3	Tutorial	Dr D Childers
	11:00-13:00	KCS13	Tutorial 1/Group 4	Tutorial	Dr J Barrow
	11:00-13:00	MT010	Tutorial 1/Group 5	Tutorial	Dr A Mackenzie
	11:00-13:00	KCS17	Tutorial 1/Group 6	Tutorial	Dr I Greig
Week 9					
Mon 23 Sep	10:00-11:00	NK1	Gene Expression (1)	Lecture	Dr A Mackenzie
	11:00-12:00	NK1	Gene Expression (2)	Lecture	Dr A Mackenzie
Tue 24 Sep					
Wed 25 Sep					
Thu 26 Sep	14:00-18:00	ZB13/14	Cloning Laboratory (Part 3)	Practical	Dr J Holland
Fri 27 Sep					
Week 10					
Mon 30 Sep	10:00-12:00	NK1	Functional Genomics (1 & 2)	Lecture	Prof S Spanò
Tue 1 Oct					
Wed 2 Oct	12:00-13:00	NK14	Gene Expression (3)	Lecture	Dr A Mackenzie
Thu 3 Oct	09:00-13:00	ZB13/14	Cloning Laboratory (Part 4)	Practical	Dr J Holland
Fri 4 Oct	10:00-11:00	G3	Gene Expression (4)	Lecture	Dr A Mackenzie
Week 11					
Mon 7 Oct					
Tue 8 Oct					
Wed 9 Oct	12:00-13:00	NK14	Protein Expression (1)	Lecture	Dr J Barrow
Thu 10 Oct	09:00-13:00	ZB13/14	Cloning Laboratory (Part 5)	Practical	Dr J Holland
Fri 11 Oct	10:00-11:00	G3	Protein Expression (2)	Lecture	Dr J Barrow
Week 12					
Mon 14 Oct	10:00-12:00	NK1	Antibodies as tools (1&2)	Lecture	Dr F Ward
Tue 15 Oct					
Wed 16 Oct	12:00-13:00	NK14	Protein Purification (1)	Lecture	Dr J Barrow

Thu 17 Oct	09:00-13:00	ZB13/14	Cloning Laboratory (Part 6)	Practical	Dr J Holland
Fri 18 Oct	10:00-11:00	G3	Protein Purification (2)	Lecture	Dr J Barrow
Week 13					
Mon 21 Oct	10:00-12:00	NK1	Protein Purification (3&4)	Lecture	Dr J Barrow
Tue 22 Oct					
Wed 23 Oct	12:00-13:00	NK14	Protein Localisation (1)	Lecture	Dr B Müller
Thu 24 Oct	09:00-13:00	ZB13/14	Cloning Laboratory (Part 7)	Practical	Dr J Holland
Fri 25 Oct	10:00-11:00	G3	Protein Localisation (2)	Lecture	Dr B Müller
Week 14					
Mon 28 Oct					
Tue 29 Oct					
Wed 30 Oct	11:00-13:00	NK14	Free for clashes		
			Rest of the week free for report writing	N/A	
Thu 31 Oct					
Fri 1 Nov					
Week 15					
Mon 4 Nov	10:00-12:00	NK1	Proteomics (1&2)	Lecture	Dr Stead
Tue 5 Nov					
Wed 6 Nov	12:00-13:00	NK14	Protein: Protein Interactions (1)	Lecture	Prof K Shennan
	24:00		Deadline Cloning Laboratory report hand-in	N/A	
Thu 7 Nov					
Fri 8 Nov	10:00-11:00	G3	Protein: Protein Interactions (2)	Lecture	Prof K Shennan
	11:00-13:00	MR265	Tutorial 2/Group 1	Tutorial	Dr S Miller
	11:00-13:00	MR252	Tutorial 2/Group 2	Tutorial	Dr F Ward
	11:00-13:00	Taylor, C16	Tutorial 2/Group 3	Tutorial	Dr D Childers
	11:00-13:00	KCS13	Tutorial 2/Group 4	Tutorial	Dr J Barrow
	11:00-13:00	MT010	Tutorial 2/Group 5	Tutorial	Dr A Mackenzie
	11:00-13:00	KCS17	Tutorial 2/Group 6	Tutorial	Dr I Greig
Week 16					
Mon 11 Nov	10:00-12:00	NK1	Protein: Protein Interactions (3&4)	Lecture	Prof K Shennan
Tue 12 Nov					
Wed 13 Nov					
Thu 14 Nov	09:00-12:00	ZG11	CAL: Protein Purification	Practical	Dr I. Greig
Fri 15 Nov	10:00-11:00	G3	Protein:Nucleic Acid Interaction (1)	Lecture	Dr B Müller
	11:00-12:00	G3	Protein:Nucleic Acid Interaction (2)	Lecture	Dr B Müller
Week 17					
Mon 18 Nov	10:00-12:00	NK1	Protein:Nucleic Acid Interaction (3&4)	Lecture	Dr B Müller
Tue 19 Nov	24:00		Deadline CAL protein purification Test	N/A	
Wed 20 Nov					
Thu 21 Nov	09:00-13:00	ZB13/14	Revision and Exam Preparation Workshop	Lab	Dr I. Greig
Fri 22 Nov	10:00-11:00	G3	Exam advice and course closing session	Lecture	Dr I. Greig

Venues

KCS13, KCS 17 - Kings College
C16 - Taylor Building
G3 - St Marys
NK1, NK14 - New King's
MR252, MR265 - MacRobert Building
MT010 - Meston Building
ZB13, ZB14, ZG11 - Zoology Building