

## Higher National Unit Specification

### General information for centres

**Unit title:** Medicinal Chemistry

**Unit code:** DP4W 35

**Unit purpose:** This Unit is designed to provide candidates with a detailed introduction to the drug design process from target selection through to lead optimisation. This Unit is suitable for candidates who are studying for an HN Chemistry or other science related qualification.

On completion of the unit the candidate should be able to:

- 1 Describe the use of biological targets for drug action.
- 2 Evaluate methods for the generation of lead compounds for drug discovery.
- 3 Evaluate the factors involved in optimising the drug like properties of a lead compound.

**Credit points and level:** 1 HN Credit at SCQF level 8: (8 SCQF credit points at SCQF level 8\*)

*\*SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

**Recommended prior knowledge and skills:** Access to this Unit will be at the discretion of the centre, however, it is recommended that candidates should have achieved the fundamental chemistry Unit at SCQF Level 7 (DH2K 34).

**Core skills:** There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

**Context for delivery:** If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

**Assessment:** The requirements for Outcomes 1, 2, and 3 is a closed book assignment under supervised, controlled conditions and a case study to integrate knowledge from all Outcomes.

Candidates must meet the level of performance specified in the evidence requirements for all three Outcomes to achieve this Unit.

## Higher National Unit specification: statement of standards

**Unit title:** Medicinal Chemistry

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

### Outcome 1

Describe the use of biological targets for drug action

#### Knowledge and/or skills

- ◆ drug targets
- ◆ protein ligand interactions
- ◆ enzyme inhibition
- ◆ biological receptors
- ◆ DNA and drug interactions

#### Evidence requirements

A candidate's response will be judged satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ describe different types of drug target
- ◆ describe the chemical principles of protein ligand interactions
- ◆ evaluate the principles of enzyme inhibition
- ◆ describe drugs that act on biological receptors
- ◆ describe the way drug can interact with DNA

Evidence should be gathered using a holistic end of unit assessment under closed book conditions, in which candidates must obtain at least 60% of the marks available in order to pass.

Candidates will also be expected to complete a case study, details of which are contained in Outcome 3.

Each candidate will need to demonstrate that they can answer questions based on a sample in any assessment. In Outcome 1, 3 out of 5 knowledge and skills items should be sampled on each occasion. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample is required each time the unit is assessed.

This assessment should take the form of a set of short answer or restricted response questions testing candidates' knowledge and understanding of the topics listed.

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Medicinal Chemistry

### Outcome 2

Evaluate methods for the generation of lead compounds for drug discovery

#### Knowledge and/or skills

- ◆ natural products as lead compounds
- ◆ lead compounds from folk medicine

#### Evidence requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ evaluate the use of natural products as lead compounds
- ◆ describe the use of Lead Compounds from folk medicine

Evidence should be gathered using a holistic end of unit assessment under closed book conditions, in which candidates must obtain at least 60% of the marks available in order to pass.

Each candidate will need to demonstrate that they can answer questions based on a sample in any assessment. In Outcome 2, all knowledge and skills items should be sampled on each occasion. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample is required each time the unit is assessed.

This assessment should take the form of a set of short answer or restricted response questions testing candidates' knowledge and understanding of the topics listed.

Candidates will also be expected to complete a case study, details of which are contained in Outcome 3.

### Outcome 3

Evaluate the factors involved in optimising the drug like properties of a lead compound

#### Knowledge and/or skills

- ◆ structure activity relationship of drugs
- ◆ analogue chemistry
- ◆ pharmacokinetics

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Medicinal Chemistry

### Evidence requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ evaluate the importance of structure activity relationship of drugs
- ◆ describe the use of analogue chemistry in lead optimisation
- ◆ evaluate the general principles of pharmacokinetics

Evidence should be gathered using a holistic end of unit assessment under closed book conditions, in which candidates must obtain at least 60% of the marks available in order to pass.

Each candidate will need to demonstrate that they can answer questions based on a sample in any assessment. In Outcome 3, two out of three knowledge and skills items should be sampled on each occasion. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample is required each time the unit is assessed.

This assessment should take the form of a set of short answer or restricted response questions testing candidates' knowledge and understanding of the topics listed.

Candidates will also be expected to complete a case study/report in open book conditions.

The case study should be approximately 1,000 words and will integrate the knowledge for all Outcomes. The case study should look at drugs from a specific therapeutic area and their mechanism of action. Should candidates fail to produce a suitable case study, a second case study should be given using a different therapeutic area.

### Assessment guidelines for Outcomes 1–3

Outcomes 1, 2 and 3 will be assessed by a closed book, end of unit assignment under supervised conditions which should be completed in about 40 minutes and a case study or report on the use of drugs in a specific therapeutic area and their mechanism of action. The closed book assessment should take the form of a set of short answer or restricted response questions testing candidates' knowledge and understanding of the topics listed.

Evidence can be generated using a sampling approach within each Outcome. Outcomes should be equally weighted across the Unit to reflect the workload of each Outcome. A different sample will be used for reassessment.

## **Administrative Information**

<b>Unit code:</b>	DP4W 35
<b>Unit title:</b>	Medicinal Chemistry
<b>Superclass category:</b>	RD
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## Higher National Unit specification: support notes

### Unit title: Medicinal Chemistry

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

### Guidance on the content and context for this Unit

This Unit is primarily intended to provide the candidate with an introduction to the concepts of medicinal chemistry and provide an overview of the drug discovery pathway. The Unit will show an understanding of the selection process for biological targets against diseases, an introduction to how lead compounds in a drug design project are generated and important processes in lead optimisation will be identified. The essential underpinning knowledge and skills gained here will be invaluable during employment or further study.

**Outcome 1** looks at biological targets for drug design. Candidates should become familiar with the following features:

- ◆ Drug targets: enzymes, receptors, DNA, essentiality, selectivity.
- ◆ Protein/ligand interactions: ionic; hydrophobic; hydrogen bonds; van der Waals interactions; covalent bonds; molecular recognition.
- ◆ Principles of enzyme inhibition : enzyme kinetics, competitive inhibitors, non competitive inhibitors, reversible inhibitors, irreversible inhibitors,  $IC_{50}$  values,  $K_I$  values.
- ◆ Drugs that act on biological receptors: Types of receptor, agonists, antagonists,  $K_d$  values.
- ◆ DNA as a drug target: Intercalating agents, Alkylating agents, chain cutting agents.

This Outcome could include a computer based activity which lets candidates selected a drug target for use in a drug design process.

**Outcome 2** looks at methods for the generation of lead compounds for drug discovery.

- ◆ Natural products: Sources, advantages, disadvantages.
- ◆ Lead Compounds from folk medicine/plant sources: examples, advantages disadvantages

This Outcome could include an experiment illustrating inhibition of an enzyme assay.

**Outcome 3** concentrates on the factors involved in optimising the drug like properties of a lead compound.

- ◆ Structure activity relationship of drugs: Importance of different functional groups, identification of SAR, pharmacophores.
- ◆ Analogue chemistry: Physical properties of compounds, toxic groups, selectivity, fluorine substitution, protecting groups.
- ◆ Pharmacokinetics: chemical stability, metabolic stability, hydrophilic/hydrophobic balance, ionisation, size, number of hydrogen bond interactions, prodrugs, bioisosteres.

## Higher National Unit specification: support notes (cont)

**Unit title:** Medicinal Chemistry

### Guidance on the delivery and assessment of this Unit

This Unit forms part of the Group Award, HND Chemistry. The Unit requires the candidate to be able to familiar with basic organic chemistry, functional groups and biological molecules. Hence it is expected to be delivered subsequent to units in chemistry in the second year of a full-time HND Chemistry programme. Where possible during the delivery, links should be drawn with other relevant areas of the course.

This Unit should be assessed with candidates producing evidence to meet the requirements for Outcomes 1,2, and 3 in an end of Unit close book assessment and case study applying and integrating knowledge from all three Outcomes.

The case study should look at drugs from a specific therapeutic area and their mechanism of action. The following applications are examples of drugs from specific therapeutic areas, which may be selected. The examples are not exhaustive and other suitable examples may be used.

- ◆ Antibiotics: Anti-metabolites, Inhibitors of cell wall synthesis, Inhibitors of protein synthesis, drug resistance mechanisms.
- ◆ Anti-cancer drugs: Oestrogen receptor antagonists, enzyme inhibitors, intercalating agents.
- ◆ Drug therapies for hypertension:  $\beta$ 1-antagonists, ACE-inhibitors.
- ◆ Anti-ulcer drugs: Cimetidine, Zantac.

Where evidence is found to be unsatisfactory, candidates may be questioned in order to identify particular problems with a specific area or areas.

In delivery of this unit an ideal opportunity exists to engage students in utilising the accessible protein databases on the Internet, as well as computer graphics of structures of proteins and protein-drug complexes. This approach is strongly encouraged given the importance of computers in the drug design process.

### Open learning

If this Unit is delivered by open or distance learning methods, additional planning resources may be required for candidate support, assessment and quality assurance.

A combination of new and traditional authentication tools may have to be devised for assessment and re-assessment purposes.

For further information and advice, please see *Assessment and Quality Assurance for Open and Distance Learning* (SQA, February 2001 — publication code A1030).

## **Higher National Unit specification: support notes (cont)**

**Unit title:** Medicinal Chemistry

### **Candidates with additional support needs**

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website **[www.sqa.org.uk](http://www.sqa.org.uk)**.

## General information for candidates

### Unit title: Medicinal Chemistry

This is a 1 credit HN Unit at SCQF level 8 intended for candidates undertaking a chemistry related qualification. It is designed to provide you with an introduction to the drug design process and an overview of medicinal chemistry.

On completion of this unit you should be able to:

- 1 Evaluate the use of biological targets for drug action.
- 2 Evaluate methods for the generation of lead compounds for drug discovery.
- 3 Evaluate the factors involved in optimising the drug like properties of a lead compound.

The three Outcomes that make up the unit are described below:

#### Outcome 1

You will be introduced to the use of biological targets as sites for drug action. The lectures/tutorials for this outcome will focus on the different types of drug target, interactions between proteins and ligands, enzyme inhibition, drugs that act on receptors and ways DNA can be targeted for therapeutic intervention.

#### Outcome 2

In this Outcome you will be introduced to the methods available for the generation of lead compounds for drug discovery. You will also learn how lead identification can be done using screening of natural products, and the use of random screening.

#### Outcome 3

This Outcome concentrates on lead optimisation. You will learn about the structure activity relationship of drugs, analogue chemistry and pharmacokinetics.

Your knowledge of the topics covered in this unit will be tested in the form of a closed book test and a case study covering Outcomes 1,2,and 3 .

To succeed in this Unit you must achieve a satisfactory level of performance in the assessment.