Changing lives through learning

Access to Higher Education Unit

This unit forms part of an Access to HE Diploma. If delivering the graded version of this unit, please refer to the Provider Handbook for details on grading descriptors and the application of these across units within your programme.

Unit Title: Chemistry of Drugs and Medicines

Graded Unit Reference Number: GA33CHE20

Ungraded Unit Reference Number: UA33CHE20

Module: Chemistry

Level: Three (3)

Credit Value: Three (3)

Minimum Guided Learning Hours: 30

Learning Outcome (The Learner will):	Assessment Criterion (The Learner can):
1. Understand key concepts and terminology used in medicinal chemistry	1.1 Explain the terms *drug* and *medicine* in relation to their biological effects.
	1.2 Describe key pharmacological terms: a. placebo b. therapeutic window c. tolerance d. side effects.
2. Understand the relationship between molecular structure and drug function	2.1 In two (2) named examples, describe similarities and differences in the structures of related drug molecules.
	2.2 Explain how structural features influence drug action.
	2.3 Explain how functional group modifications can improve drug effectiveness, delivery, or safety.
3. Understand analytical techniques used for drug detection	3.1 Compare and contrast the principles of common spectroscopic techniques used in drug detection.
	3.2 Describe the principles of chromatographic techniques used in drug detection.

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4.	Understand the importance of isomerism in drug action	4.1	Distinguish between structural isomerism and stereoisomerism.
		4.2	Identify and classify geometric isomers as *cis* or *trans,* and describe the significance of geometric isomerism in drug function and efficacy.
		4.3	Identify chiral molecules and describe how optical isomerism can influence the safety of drugs.
5.	Evaluate processes involved in drug discovery and design	5.1	Analyse methods used to identify potential new drug molecules.
		5.2	Evaluate how computer-aided drug design contributes to the development and optimisation of new drugs.

Indicative Content

Learners could cover the following:

(The information below is provided for guidance only and is not mandatory)

LO1

AC1.1

Definitions of *drug* and *medicine*

Differences between drugs and medicines (e.g. purpose, formulation, regulation)

Types of drug effects:

- Therapeutic effects
- Side effects
- Toxic effects

Role of receptors, enzymes and biological targets

Examples of drugs vs medicines (e.g. caffeine vs paracetamol tablet)

AC1.2

Placebo

- Definition and placebo effect
- Use in clinical trials (control groups)

Therapeutic window

- Minimum effective concentration (MEC) and maximum safe concentration (MSC)
- Narrow vs wide therapeutic window
- Implications for safety and dosage

Tolerance

- Pharmacodynamic and metabolic tolerance
- Impact on dosage and long-term use

Side effects

- Types (mild, severe, dose-dependent, allergic, idiosyncratic)
- Factors influencing side effects (dose, patient variation)

LO2

AC2.1

Structural features of drug classes (e.g. beta-lactam antibiotics, opioids)

Functional groups and core structures

Structural analogues and their effects

Bioisosteres and isosteres

Examples:

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	• Paracetamol vs phenacetin • Ibuprofen vs naproxen AC2.2 Structure–activity relationships (SAR) Role of functional groups in: • Binding to receptors (hydrogen bonding, ionic interactions) • Selectivity and specificity Influence of: • Molecular shape and size • Polarity and solubility • Lipophilicity vs hydrophilicity Biological interactions (drug–receptor binding, enzyme inhibition) AC2.3 Functional group modification strategies: • Hydroxyl → ether (bioavailability) • Carboxylic acid → ester (absorption) • Amine modification (lipophilicity) Effects on: • Absorption (e.g. membrane permeability) • Distribution (e.g. blood–brain barrier) • Metabolism and stability • Toxicity reduction Prodrugs and metabolic activation Examples: • Morphine vs codeine • Salicylic acid vs aspirin • Enalapril vs enalaprilat
LO3	AC3.1 Principles of interaction with electromagnetic radiation Key techniques: • UV-Vis spectroscopy (absorbance, quantification) • Infrared (IR) spectroscopy (functional group identification, fingerprint region) • Nuclear Magnetic Resonance (NMR) spectroscopy (molecular structure) • Mass spectrometry (m/z ratio, identification) Advantages and limitations of each method Applications in: • Pharmaceutical analysis • Forensic science AC3.2 Separation principles (stationary vs mobile phase) Techniques: • Thin-layer chromatography (TLC) • High-performance liquid chromatography (HPLC) • Gas chromatography (GC) Concepts: • Retention time • Polarity and solubility Coupled techniques (e.g. GC–MS, LC–MS) Applications: • Drug testing (clinical/forensic)

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	• Quality control and impurity detection
LO4	AC4.1 Definitions: • Structural isomerism (different connectivity) • Stereoisomerism (same connectivity, different spatial arrangement) Types of structural isomerism (chain, positional, functional group) Types of stereoisomerism (geometric, optical) AC4.2 Cis–trans (E/Z) isomerism: • Conditions for geometric isomerism (double bond or ring restriction) Differences in: • Shape • Polarity • Biological activity Impact on: • Receptor binding • Pharmacokinetics and pharmacodynamics Examples: • Cisplatin vs transplatin • Tamoxifen isomers AC4.3 Definition of chirality and chiral centre Enantiomers (R/S forms) Key concepts: • Non-superimposable mirror images • Optical activity Biological significance: • Stereospecific receptor interactions • Differences in efficacy and toxicity Examples: • Ibuprofen enantiomers • Thalidomide case study Importance of single-enantiomer drugs
LO5	AC5.1 Natural sources: • Plants, microorganisms, marine organisms Synthetic methods: • Combinatorial chemistry Screening approaches: • High-throughput screening (HTS) • Target-based vs phenotypic screening Advantages and limitations of each method Concept of lead compounds and optimisation AC5.2 Computer-aided drug design (CADD): • Molecular modelling • Docking studies • Molecular dynamics Structure–activity relationship (SAR) and QSAR Virtual screening (ligand-based and structure-based)

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	Benefits: • Reduced cost and time • Prediction of drug–target interactions Limitations: • Model accuracy • Need for experimental validation

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