

Molecular Pharmacology

Code: 100902
ECTS Credits: 6

Degree	Type	Year	Semester
2500252 Biochemistry	OT	4	0

Contact

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Use of languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

José Miguel Lizcano de Vega
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Enrique Claro Izaguirre
Alberto Fernández de Arriba

Prerequisites

Good Knowledge of the principles of Biochemistry and Signal Transduction

Objectives and Contextualisation

Use of critical thinking in Biochemistry and Molecular Pharmacology. Introduce students to drug development and the biochemistry of drugs.

Skills

- Apply general laboratory security and operational standards and specific regulations for the manipulation of different biological systems.
- Apply the legal and ethical principles that govern the development and application of molecular life sciences.
- Apply the principal techniques used in biological systems: methods of separation and characterisation of biomolecules, cell cultures, DNA and recombinant protein techniques, immunological techniques, microscopy techniques, etc.
- Clearly perceive current advances and possible future developments by reviewing scientific and technical literature in the area of biochemistry and molecular biology.
- Collaborate with other work colleagues.
- Describe intercellular and intracellular communication systems that regulate the proliferation, differentiation, development and function of animal and plant tissues and organs.
- Design experiments and understand the limitations of experimental approaches.
- Interpret experimental results and identify consistent and inconsistent elements.

- Manage bibliographies and interpret the information in the main biological databases, and also know how to use basic ICT tools.
- Manage information and the organisation and planning of work.
- Read specialised texts both in English and ones own language.
- Take responsibility for one's own learning after receiving general instructions.
- Think in an integrated manner and approach problems from different perspectives.
- Use ICT for communication, information searching, data processing and calculations.
- Write an article on a scientific or technical topic aimed at the general public.

Learning outcomes

1. Apply general laboratory security and operational standards and specific regulations for the manipulation of different biological systems.
2. Collaborate with other work colleagues.
3. Correctly use the basic terminology of pharmacology and its principles.
4. Describe the principal biochemical techniques for studying the interaction between ligands and receptors and the molecular action mechanisms of drugs.
5. Design experiments and understand the limitations of experimental approaches.
6. Exemplify action mechanisms of drugs that act on membrane receptors, signal transduction, ion channels, transport systems, enzymes and gene expression.
7. Interpret experimental results and identify consistent and inconsistent elements.
8. Know and comply with the principles of bioethics and professional codes of conduct in R&D and in pre-clinical and clinical trials.
9. Manage information and the organisation and planning of work.
10. Read specialised texts both in English and ones own language.
11. Solve problems in applications of biochemistry to pharmacology and toxicology.
12. Take responsibility for one's own learning after receiving general instructions.
13. Think in an integrated manner and approach problems from different perspectives.
14. Use ICT for communication, information searching, data processing and calculations.
15. Use bioinformatic databases, algorithms and programmes to identify targets for therapy, vaccination and diagnosis.
16. Write an article on a scientific or technical topic aimed at the general public.

Content

1. Molecular Pharmacology and drug development

- 1.1. What is Molecular Pharmacology?
- 1.2. Strategies of drug development

2. Radioligand binding and functional studies of ligand-receptor interaction

- 2.1. Saturation and competition binding
- 2.2. Dose-response curves
- 2.3. From receptor-occupation to stimulus and response

3. Pharmacokinetics and Phamacodynamics

- 3.1. Drug absorption, transport and distribution
- 3.2. Drug Metabolism
- 3.3. Phamacokinetics

4. Molecular aspects of drugs that interact with transporters: representative examples

- 4.1. CNS stimulants: cocaine and methamphetamine
- 4.2. Antidepressant drugs: fluoxetine and tricyclic antidepressants
- 4.3. Diuretic (water pills): furosemide
- 4.4. Cardiac stimulants: digoxin
- 4.5. Inhibition of stomach acid secretion: omeprazole
- 4.6. multidrug resistance: MDR/ABD transporters

5. Molecular aspects of drugs that interact with ionic channels: representative examples

- 5.1. Local anesthetics
- 5.2. Antihypertensive drugs: dihydropyridine and other calcium channel blockers
- 5.3. Hypnotic and anxiolytic drugs: benzodiazepines and barbiturates

6. Molecular aspects of drugs that interact with receptors: representative examples

- 6.1. Drugs for asthma: salbutamol and salmeterol
- 6.2. Drugs to treat allergies: Antihistamines
- 6.3. Corticosteroids and inflammation
- 6.4. James Black 's discoveries: propranolol and cimetidine
- 6.5. Antihypertensive drugs: angiotensin II receptor antagonists

7. Molecular aspects of drugs that interact with enzymes: representative examples

- 7.1. Antiinflammatories: aspirin, paracetamol i ibuprofen
- 7.2. Treatment of hypercholesterolemia: statins
- 7.3. Antihypertensive drugs: ACEinhibitors
- 7.4. Vasodilator medication: nitrovasodilator and phosphodiesterase inhibitors

8. Pharmacology of cancer: an overview of different molecular targets

- 8.1. Chemotherapy
- 8.2. Therapeutic strategies to inhibit growth factors: monoclonal antibodies and soluble receptors
- 8.3. Drugs inhibiting tyrosine kinase receptors: monoclonal antibodies and tyrosine-kinase inhibitors
- 8.4. Pharmacological inhibitors of MAPK pathways
- 8.5. Phosphoinositide 3-kinase inhibitor and multikinase inhibitors
- 8.6. Drugs for hormone-sensitive cancer

Methodology

Molecular Pharmacology work is divided between lectures, practical labs, sessions of students' oral presentations and tutorials, as stated below.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Lectures	36	1.44	4, 8, 16, 6, 9, 7, 10, 13, 11, 3, 15
Oral presentations	4	0.16	14, 2, 4, 8, 16, 6, 9, 7, 10, 13, 11, 12, 3, 15
Practical labs	12	0.48	14, 1, 2, 4, 8, 5, 6, 9, 7, 10, 13, 11, 3
Type: Supervised			
Activities at Aula Moodle	1	0.04	14, 2, 4, 5, 6, 9, 7, 10, 13, 11, 12, 3, 15
Tutorials	2	0.08	14, 2, 4, 6, 9, 7, 10, 13, 11, 12
Type: Autonomous			
Active studying at home	57	2.28	14, 2, 4, 5, 6, 9, 7, 10, 13, 11, 12, 3, 15
Essay and preparation of oral presentation of the molecular aspects of a drug	22	0.88	14, 2, 4, 16, 6, 9, 7, 10, 13, 11, 12, 3, 15
Preparation of practical labs	4	0.16	14, 2, 4, 8, 5, 16, 6, 9, 7, 10, 13, 11, 12, 3, 15

Evaluation

Final mark of Molecular Pharmacology will be calculated from the marks of the practical labs (10%), essay and oral presentation of molecular aspects of a drug (23%), exam 1 (20%) and exam 2 (47%).

For students failing an exam (mark under 5) or wishing to improve their marks of exam 1 or/and 2, there will be a second change, a retake exam. The mark of this retake exam will overwrite the marks of exam 1 or/and 2. To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score. Moreover, students missing more than 20% of programmed practical sessions will be also graded as "No Avaluable".

To pass Molecular Pharmacology students need a mark equal or higher than 5 in both exams or in the retake exams.

Assistance to the practical labs and the total of the students' oral presentations is mandatory.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Essay and oral presentation of molecular aspects of a drug	23 %	4	0.16	14, 2, 4, 5, 16, 6, 9, 7, 10, 13, 11, 12, 3, 15
Exam 1 (themes 1-3 and practical lessons)	20 %	2	0.08	14, 4, 5, 6, 9, 7, 10, 13, 11, 12, 3, 15

Exam 2 (Themes 4-8)	47 %	2	0.08	14, 4, 5, 6, 9, 7, 10, 13, 11, 12, 3, 15
Practical lessons evaluation (professional attitude, essay and protocol)	10 %	4	0.16	14, 1, 2, 4, 8, 5, 6, 9, 7, 13, 11, 12, 3, 15

Bibliography

- **Farmacología**, 8ª Edición. *H.P. Rang, M.M. Dale, J.M.Ritter, R.J.Flower*, Elsevier 2016
- **Goodman Gilman: Las bases farmacológicas de la terapéutica**, 12ª Edición. *L.L.Bruton, J.S: Lazo, K.L.Parker*, McGraw-Hill 2012
- **Farmacología Humana**, 6ª ed, *J.Florez*, Masson 2013
- **G protein-coupled receptors: Molecular Pharmacology**. *G.Vauquelin, B.Von Mentzer* Willey 2007
- **Molecular Neuropharmacology: A foundation for Clinical Neuroscience**, 3rd edition. *Eric J.Nestler, Steven E. Hyman, Robert C. Malenka*. Ed. Mc Graw-Hill 2015
- **Human drug metabolism. An introduction**. 2nd edition, *M.D.Coleman*. Wiley-Blackwell 2010
- **Biochemistry and Molecular Biology Education: Analyzing ligand depletion in a saturation equilibrium binding experiment**. pp. 428. *E Claro* . IUBMB 2006