

MÓDULO	MATTER	COURSE	SEMESTER	CRÉDITS	KIND
Optional subject	Bioinorganic chemistry	2º and later	1º(one group) y 2º (two groups)	6	Optional
<b>TEACHERS</b> <sup>(1)</sup>			COMPLETE CONTACT ADDRESS FOR TUTORIALS (Postal address, telephone, email, etc..)		
<ul style="list-style-type: none"> <li>Juan Niclós Gutiérrez</li> <li>Josefa María González Pérez</li> <li>Alicia Domínguez Martín</li> </ul>			Dpt. of Inorganic Chemistry, 3rd floor, Pharmacy faculty. Emails: Juan Niclós Gutiérrez ( <a href="mailto:jniclos@ugr.es">jniclos@ugr.es</a> ) Josefa María González Pérez ( <a href="mailto:jmgp@ugr.es">jmgp@ugr.es</a> ) Alicia Domínguez Martín ( <a href="mailto:adominguez@ugr.es">adominguez@ugr.es</a> )		
			TIMETABLE OF TUTORIES AND / OR LINK TO THE WEB PAGE WHERE THE TUTORIAL SCHEDULES CAN BE CONSULTED <sup>(1)</sup>		
			Juan Niclós Gutiérrez (L, J: 09,30-11,30 y 16,00-17,00) Josefa M <sup>a</sup> . González Pérez (L, M y J de 11,30 a 13,30) Alicia Domínguez Martín (L, M y J de 8,30 a 11,30)		
<b>DEGREE IN WHICH IT IS IMPARTED</b>			OTHER DEGREES TO WHICH IT COULD BE OFFERED		
Degree in Pharmacy			Degree in Chemistry and Degree in Biology		
<b>PREREQUISITES AND / OR RECOMMENDATIONS</b> (if applicable)					
<p>- Recommended to have approved the subjects of Inorganic Chemistry, and Biochemistry. Have adequate knowledge about:</p> <ul style="list-style-type: none"> <li>Structure and conformation of proteins</li> </ul>					

<sup>1</sup> See possible update in Identified Access> Applications> Teacher Organization

(∞) This teaching guide must be completed following the "Evaluation and Qualification Regulations for students of the University of Granada" ([http://secretariageneral.ugr.es/pages/normativa/fichasugr/ncg7121/!](http://secretariageneral.ugr.es/pages/normativa/fichasugr/ncg7121/))

- Coordination Chemistry
- Knowledge of the Bioelements

#### **BRIEF DESCRIPTION OF CONTENTS (ACCORDING TO DEGREE VERIFICATION MEMORY)**

BLOCK 1: GENERALITIES.

BLOCK 2: BIOINORGANIC CHEMISTRY OF SOME BIOLOGICAL SYSTEMS.

BLOCK 3: THERAPEUTIC ACTION AND TOXICITY.

#### **GENERAL AND SPECIFIC COMPETENCES**

##### A. General Competences

GC1. Identify, design, obtain, analyze, control and produce drugs and medicines, as well as other products and raw materials of sanitary interest for human or veterinary use.

GC4. Design, prepare, supply and dispense medicines and other products of sanitary interest.

GC11. Evaluate the toxicological effects of substances and design and apply the corresponding tests and analyzes.

##### B. Specific competences

CEM1.1 Identify, design, obtain, analyze and produce active ingredients, drugs and other products and materials of health interest.

CEM1.4 Estimate the risks associated with the use of chemical substances and laboratory processes.

CEM1.9 Know the origin, nature, design, procurement, analysis and control of medicines and health products.

#### **OBJECTIVES (EXPRESSED AS EXPECTED RESULTS OF THE TEACHING)**

With the subject of BIOINORGANIC CHEMISTRY, the student is expected to:

- Know the implications of metallic elements in biological systems, with special emphasis on the study of metalloprotein active centers as the main responsible for the activity they perform in biological systems.
- Introduce the student to the knowledge of the aspects of medicinal inorganic chemistry, specifically a subject dedicated to the study of inorganic compounds with antitumor action and another where the student is introduced in the field of toxicology of metals, with special mention of your chelation therapy.

#### **DETAILED SUBJECT OF THE MATTER**



## **THEORETICAL SUBJECT:**

### **Block I            GENERALITIES**

**Topic 1:**            INTRODUCTION AND GENERAL CONSIDERATIONS REGARDING THE PRESENCE OF METALS IN BIOLOGICAL SYSTEMS (B. S.).

Origin of the presence of metals in Biological Systems.

Chemical elements that are part of the Biological Systems.

Biological functions of inorganic elements.

**Topic 2:**            INTERACTIONS OF METALLIC IONS WITH BIOLOGICAL LIGANDS.

2.1 Generalities

2.2 General properties of metal cations.

Biological ligands (Biologands).

Metal-protein interaction.

Stability of complexes and factors that affect it.

Effects Chelate and Macrochelate.

**Topic 3:**            SOME ELECTRONIC CONFIGURATIONS OF IONS OF INTEREST IN BIOLOGICAL SYSTEMS.

3.1 Vanadium

3.2 Chrome

3.3 Manganese

3.4 Iron

3.5 Cobalt

3.6 Nickel

3.7 Copper

**Topic 4:**            METHODOLOGY AND EXPERIMENTAL TECHNIQUES USED IN BIOINORGANIC CHEMISTRY.

4.1- Possibilities of approach of the investigation in Bioinorganic Chemistry.

4.2- Brief Introduction of the different methods used in the characterization of model compounds with biological ligands and similar.



## **Block II      BIOINORGANIC CHEMISTRY OF SOME BIOLOGICAL SYSTEMS**

### Topic 5: BIOINORGANIC CHEMISTRY OF OXYGEN.

- 5.1 General features
- 5.2 Activación del Oxígeno
- 5.3 Biological oxidation
- 5.4 Transport and storage of dioxygen

### Topic 6: BIOINORGANIC CHEMISTRY OF IRON

- 6.1 General features
- 6.2 Iron proteins containing heme groups
- 6.3 Iron / sulfur proteins
- 6.4 Systems containing Fe-O-Fe units
- 6.5 Metabolism of iron

### Topic 7: COPPER BIOINORGANIC CHEMISTRY.

- 7.1 General features. Copper type1; Copper type 2; Copper type3
- 7.2 Oxidases
- 7.3 Electron transporters
- 7.4 Superoxide dismutase (SOD)
- 7.5 Hemocyanins
- 7.6 Copper metabolism

### Topic 8: BIOINORGANIC CHEMISTRY OF COBALT

- 8.1 General features
- 8.2 B12 vitamin.
- 8.3 Cobalt metabolism

## **Block III      THERAPEUTIC ACTION AND TOXICITY**



## Topic 9: ANTITUMORAL COMPOUNDS

- 9.1 Cancer. Origin and treatment
- 9.2 Structure-antitumor activity relationship. Empirical rules
- 9.3 Antitumor activity-reactivity against DNA
- 9.4 Some considerations about the coordination chemistry of Pt
- 9.5 Structural characteristics of DNA. Functional groups of DNA as a ligand
- 9.6 Reaction modes of Pt (II) complexes with DNA
- 9.7 Other compounds with antitumor properties

## Topic 10: TOXICOLOGY OF SOME TRANSITION METALS

- 10.1 Generalities
- 10.2 Defense and detoxification mechanisms
- 10.3 Some typical pollutants

### PRACTICAL TOPICS:

#### Laboratory practices

NOTEBOOK Nº 1	$(\text{AdeH}_2)[\text{Cu}(\text{HEDTA})(\text{H}_2\text{O})] \cdot 2\text{H}_2\text{O}$
NOTEBOOK Nº 2	$[\text{Cu}(\text{MIDA})(\text{AdeH})(\text{H}_2\text{O})] \cdot \text{H}_2\text{O}$
NOTEBOOK Nº 3	$[\text{Cu}(\text{NBzIDA})(\text{AdeH})(\text{H}_2\text{O})] \cdot \text{H}_2\text{O}$

#### Execution of the Practical classes

- Step 1. Explanation in the classroom of the methodology to be developed in the practices.
- Step 2. Realization, in laboratory, of the synthesis of the compound (individually by each student)
- Step 3. Characterization of the compounds, with all the analytical and spectroscopic data included in the notebook. It will be done in the classroom together with the teacher

### BIBLIOGRAPHY

#### A) FUNDAMENTAL BIBLIOGRAPHY:

- "QUÍMICA BIOINORGÁNICA" J. S. Casas, V. Moreno, A. Sánchez, J. L. Sánchez, J. Sordo. Ed. Síntesis (2002).
- "QUÍMICA BIOINORGÁNICA" Enrique Baran Ed. McGraw-Hill
- "BIOINORGANIC CHEMISTRY: INORGANIC ELEMENTS IN THE CHEMISTRY OF LIFE" Wolfgang Kaim and Brigitte Schwederski. Ed. John Wiley and Sons.



"INTRODUCCION A LA QUIMICA BIOINORGANICA" M. Vallet, J. Faus, E. García-España y J. Moratal Ed. Síntesis (2003).

B) COMPLEMENTARY BIBLIOGRAPHY:

"PRINCIPLES OF BIOINORGANIC CHEMISTRY" Stephen J. Lippard and Jeremy M. Berg. Ed. University Science Books.

"BIOINORGANIC CHEMISTRY" Bertini; Gray; Lippard and Valentine. Ed. University Science Books.

"THE BIOLOGICAL CHEMISTRY OF THE ELEMENTS. THE INORGANIC CHEMISTRY OF LIFE" J.J.R. Frausto da Silva and R.J.P. Williams. Ed. Oxford University Press.

C) ENCYCLOPEDIAS AND SERIES:

"METAL IONS AND BIOLOGICAL SYSTEMS" Astrid Sigel and Helmut Sigel. Ed. Marcell Dekker.

"HANDBOOK OF THE TOXICOLOGY OF METALS" Lars Friberg; Gunnar F. Nordberg and Velimir B. Vouk. Ed. Elsevier.

"HANDBOOK OF NUCLEOBASES COMPLEXES" J. R. Lusty, P. Wearden, V. Moreno . CRC Press (vol. II)

RECOMMENDED WEBSITE LINKS

<http://www.hindawi.com/journals/bca/>

(Bioinorganic Chemistry and Applications, open access journal)

[http://investigacion.ugr.es/ugrinvestiga/static/Buscador/\\*/grupos/ficha/FQM283](http://investigacion.ugr.es/ugrinvestiga/static/Buscador/*/grupos/ficha/FQM283)

[http://biomec.ugr.es/datos\\_inicio/](http://biomec.ugr.es/datos_inicio/)

TEACHING METHODOLOGY

The teachings will be based mainly on expository theoretical classes.

Expository lessons of the contents of each theme supported in presentations.

The material used in class will be available to the students at the beginning of each topic in the meadow website (SWAD and / or teaching board).

Laboratory practices with sessions to discuss the results of the isolation techniques and those used in the characterization of the compounds used.



<b>ACTIVITY PROGRAM</b>					
<b>Second term</b>	<b>Topics of the agenda</b>	<b>Classroom activities</b> (NOTE: Modify according to the teaching methodology proposed for the subject)	<b>No Classroom activities</b> (NOTE: Modify according to the teaching methodology proposed for the subject)		
		<b>Theoretical sessions Practical sessions (*) Exhibitions and seminars Collective tutorials (**) Exams</b>	<b>Individual tutorials</b> <b>Study and individual work of the student</b> <b>Team work</b>		
<b>Week 1</b>	1	3		3	
<b>Week 2</b>	2	4		5	
<b>Week 3</b>	3	4		5	
<b>Week 4</b>	3	3		9	
<b>Week 5</b>	4	4		5	
<b>Week 6</b>	5	4		6	
<b>Week 7</b>	6	5		7	
<b>Week 8</b>	6	3		4	
<b>Week 9</b>	7	5		7	
<b>Week 10</b>	7-8	5		7	
<b>Week 11</b>	8	5		6	
<b>Week 12</b>	9	4		7	
<b>Week 13</b>	9	4		6	
<b>Week 14</b>	10	4		7	
<b>Week 15</b>	10	3		6	
<b>Total hours</b>		<b>60</b>		<b>90</b>	

(\*)The internships will be given to groups of 15 students during 3 consecutive sessions of 2.5 hours



**(\*\*)The tutorials will be distributed throughout the course according to the criteria of the student and the teacher**

**EVALUATION (EVALUATION INSTRUMENTS, EVALUATION CRITERIA AND PERCENTAGE ON THE FINAL QUALIFICATION, ETC.)**

For the qualification in that evaluation the following instruments will be taken into account:

- One Control during class hours (or at a time agreed with students, as the only alternative date).
- Global evaluation at the end of the subject.
- Assessment of the practices (to overcome the practices it will be essential that the student finish the practices, and, therefore, (1) collect the isolated product in the laboratory and (2) complete the isolation and characterization of the assigned compound).
- The passing of any of the tests will not be achieved without a uniform and balanced knowledge of the whole subject.

Evaluation criteria and percentage on the final grade:

The evaluation criteria will be clarified beforehand, based on the correction of exams. For the final qualification of the subject the following percentages will be considered

- Note of theory: 70%.
- Practice note: 20%.
- Attendance to class and the accomplishment of programmed activities: 10%

**DESCRIPTION OF THE EVIDENCE THAT WILL BE PART OF THE FINAL UNIQUE EVALUATION ESTABLISHED IN THE "REGULATIONS OF EVALUATION AND GRADING OF THE STUDENTS OF THE UNIVERSITY OF GRANADA"**

Those students who can not be accepted for various reasons to the continuous assessment plan, may benefit from a final single evaluation process, requesting the Director of the Department in the first two weeks of the subject. Said evaluation will consist of a single written test (or oral), where the knowledge of the subject will be assessed and whose qualification will be considered as the final grade of the subject

**ADDITIONAL INFORMATION**

The students of Bioinorganica Chemistry will be informed in a timely manner of the research that is being done in this field. In this sense, the progress presented biannually in the most representative congress in the area, at European level, will be reported. European Biological Inorganic Chemistry Conference (EUROBIC, September 2012, the professors of the subject were involved in the organization of the 11th edition of the same ([www.eurobic11.com](http://www.eurobic11.com)), as well as other meetings, national (AEBIN) or international, of Bioinorganic nature. For additional information, consult the teaching guide or the website of the Faculty of Pharmacy: <http://farmacia.ugr.es/cont.php?sec=2&pag=29>

