Use of languages

Principal working language: english (eng)
Some groups entirely in English: Yes
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Objectives and Contextualisation

"Metalls en Biologia i Medicina" is a fourth-year subject in which the student must acquire a general view of the fundamental contents of the area of knowledge of Bioinorganic Chemistry.

The general objective of this subject is that, from the general knowledge of chemistry, biology, inorganic chemistry and biochemistry acquired in previously studied subjects, the student reaches a basic knowledge of how important is the presence of metals in living beings both from the point of view of Biology and of Medicine.

The training objectives of the subject can be summarized in:
1) To know and understand the essentiality and toxicity of metals in biological systems and their importance and use in diagnosis and therapy
2) To know the main types of metalloproteins and metal cofactors, their functions and the role of the metal center in each of them
3) To know the main drugs, both in therapy and diagnosis, that contain metals and their mechanisms of action
4) To learn to experimentally work with biological material
Skills

- "Interpret data obtained by means of experimental measures, including the use of IT tools; identify their meaning and relate the data with appropriate chemistry, physics or biology theories."
- Adapt to new situations.
- Communicate orally and in writing in one's own language.
- Develop synthesis and analyses studies in chemistry from previously established procedures.
- Evaluate the health risks and environmental and socioeconomic impact associated to chemical substances and the chemistry industry.
- Handle chemical products safely.
- Handle standard instruments and material in analytic and synthetic chemical laboratories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Manage, analyse and synthesise information.
- Obtain information, including by digital means.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Resolve problems and make decisions.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Show initiative and an enterprising spirit.
- Show sensitivity for environmental issues.
- Use IT to treat and present information.
- Use the English language properly in the field of chemistry.
- Work in a team and show concern for interpersonal relations at work.

Learning outcomes

1. Adapt to new situations.
2. Communicate orally and in writing in one's own language.
3. Define the basic principles of drugs.
4. Describe the basic principles of biominalisation processes and the most relevant biominerals.
5. Distinguish the different detoxification agents of living organisms contaminated by metals and their methods of action.
6. Distinguish the main types of metal cofactor and their functions in metalloprotein.
7. Distinguish the main types of metalloprotein and their functions in living organisms.
8. Identify the main drugs (for therapy and diagnosis) that contain metals, and understand their mechanisms.
9. Identify the maximum limits of presence of different metals in living organisms and in the environment.
10. Identify the risks involved in the handling of chemical compounds used in biological chemistry, and apply suitable protocols for the storage or elimination of the waste generated.
11. Learn autonomously.
12. Manage the organisation and planning of tasks.
13. Manage, analyse and synthesise information.
14. Obtain information, including by digital means.
15. Perform synthesis of compounds metals that can be considered models of active centres of metalloprotein and study their activity.
16. Properly interpret data obtained in the laboratory after computerised treatment and on the basis of the acquired knowledge.
17. Propose creative ideas and solutions.
18. Reason in a critical manner.
19. Recognise and analyse situations of metal-biomolecule interaction by reading articles related with the problem.
20. Recognise the common chemical compounds found in the laboratory that require special safety measures.
21. Recognise the essentiality and toxicity of metals in biological systems.
22. Recognise the influence of metals on the structure and stability of metalloprotein.
23. Recognise the main metal storage and transport proteins, as well as their mechanisms.
24. Recognise the main oxygen storage and transport proteins, as well as their mechanisms.
25. Remember the most common English terms used in the world of bioorganic chemistry, and interpret an article in English in a reasonable time.
26. Resolve problems and make decisions.
27. Show initiative and an enterprising spirit.
28. Show sensitivity for environmental issues.
29. Study the action of certain metalloproteins in consideration of their characteristic substrates by means of common chemistry laboratory techniques.
30. Use IT to treat and present information.
31. Use standard instruments and materials to characterise the activity of certain metalloproteins in consideration of their characteristic substrates.
32. Work experimentally with biological material (inert, aseptic and/or controlled atmospheres).
33. Work in a team and show concern for interpersonal relations at work.

Content

Introduction

Chemical elements of biological relevance: the frontier between essentiality in the oceans and living beings. Metals of pharmacological interest.

Metal ions and proteins. Bonding, stability and folding

The metallic cofactor. Amino acids as ligands of metal ions. Metalloproteins...
Special cofactors and metal clusters
Structural characteristics, functionality and abundance. Fe-S cofactors ar

Transport and storage of metal ions in living systems
Bioavailability of metal ions. The case of Fe. General properties of transp

Metallic storage mechanisms: the case of ferritin and metallothioneins.

Biominerals and biomineralization
Types of biominerals and their function: the case of Ca, Si, oxides and sul
of Fe

The metallic elements in medicine
Anticancer therapeutic agents. Examples and mechanisms of action of ci

Antiarthritic agents of Au. Antiulcer drugs of Bi. The Li and the control of bipolar disorders. Imaging and diagnost

Contrast agents for Magnetic Resonance Imaging (MRI): the case of Gd(III).
Methodology

**Classes of theory - Lectures:** Students will acquire the knowledge of the subject by personally attending the classes taught by the teacher. Subsequently, this knowledge should be complemented with the individual work of the student consulting the bibliography that the teacher will indicate and participating in the accomplishment of the programmed activities. Master classes are a type of activity that requires little interaction with the student; they are conceived as fundamentally unidirectional transmission of knowledge of the teacher to the student.

Also, each student will prepare a topic of his choice from a list of proposed topics, which will be exposed in class.

**Classes of problems and Seminars:** The knowledge acquired in theory classes and in personal study, will be applied to solving problems and/or exercises in the form of practical cases or theoretical assumptions. During this process, we will try to encourage the participation of students through the dynamization of classes by the resolution of cases and questions on a regular basis. Thus, in these sessions, the solutions proposed by the students will be discussed, based on their autonomous work developed individually or in groups, for previously raised cases. The faculty will help develop critical thinking and logical reasoning, in order to increase students' ability to solve problems.

**Practical classes:** Laboratory practices will be carried out (3 sessions of 4 h each) related to the topics of the subject through which the student will become familiar with a series of basic laboratory techniques related to the manipulation of products and chemical reagents and biological material as well as the use of small equipment typical of this area of knowledge and the most common instrumental techniques in this discipline. The laboratory work will be done individually and will be supervised by the teacher who will evaluate the students considering their attention and performance in the laboratory as well as the reports (laboratory notebook) made.
# Activities

<table>
<thead>
<tr>
<th>Title</th>
<th>Hours</th>
<th>ECTS</th>
<th>Learning outcomes</th>
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<tr>
<td>Laboratory Practices</td>
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<td>1.44</td>
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<td>Individual work</td>
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<td>3.36</td>
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</tr>
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# Evaluation

The competences of this subject will be evaluated continuously through two modules that include written tests an
It is necessary to obtain a grade $\geq 5.0$ in the overall evaluation to pass the subject. 

The non-presented: A student receives the grade of not presented if he/she did not attend any written test or delivered the reports and/or the written works resolved on the dates indicated by the teacher.

1. **Written tests (80%)**

   They will consist of two compulsory partial exams. In order to consider a student as “Not Presented” (NP) it will be necessary that he/she has not done any of the partial exams or the recovery exam (final exam or repechage).

   To pass the subject by partials, you must have a minimum grade of 5.0 points in each partial and the final grade will be the simple average of the marks of the two partials that will be increased with the 10% of the overall grade obtained in the presentation of the theme prepared for each student. For students who do not pass one or both of them, there will be a repechage. In this case, the grade will be the weighted average of the final written test (70%) and of the marks obtained in the two partial tests (remaining 30%).

   These exams will consist mainly of short theoretical questions and some practical exercises or cases to solve.

   **1.a) First partial exam**

   There will be a first partial exam, which will collect approximately 50% of the subject matter. The mark obtained in this first part will be increased with a 10% of the average mark obtained in the controls carried out in class during the first part of the course.

   The result of this operation will determine the final grade of the first partial.

   **1.b) Second partial exam**

   The second test of evaluation of the subject will be done once the theoretical classes are finished and may include some of the concepts that have already been evaluated in the first partial exam as well as the practical classes. The note obtained in this second partial will be increased with a 10% of the average mark obtained in the controls carried out in class during the second part of the course. The result of this operation will determine the final grade of the second partial.

   **1.c) Recovery exam**

   It will be done after the two partials and will include all the course material. In order to attend this final exam (recovery activity), the student must have been previously evaluated in the continuous assessment activities that are equivalent to a minimum of 2/3 of the final grade.

2. **Laboratory module (20%)**

   Students will deliver reports on the practices carried out, and their skills in the laboratory will be assessed.
Evaluation activities

<table>
<thead>
<tr>
<th>Title</th>
<th>Weighting</th>
<th>Hours</th>
<th>ECTS</th>
<th>Learning outcomes</th>
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<tr>
<td>Written exercises</td>
<td>80%</td>
<td>12</td>
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Bibliography

Basic bibliography: